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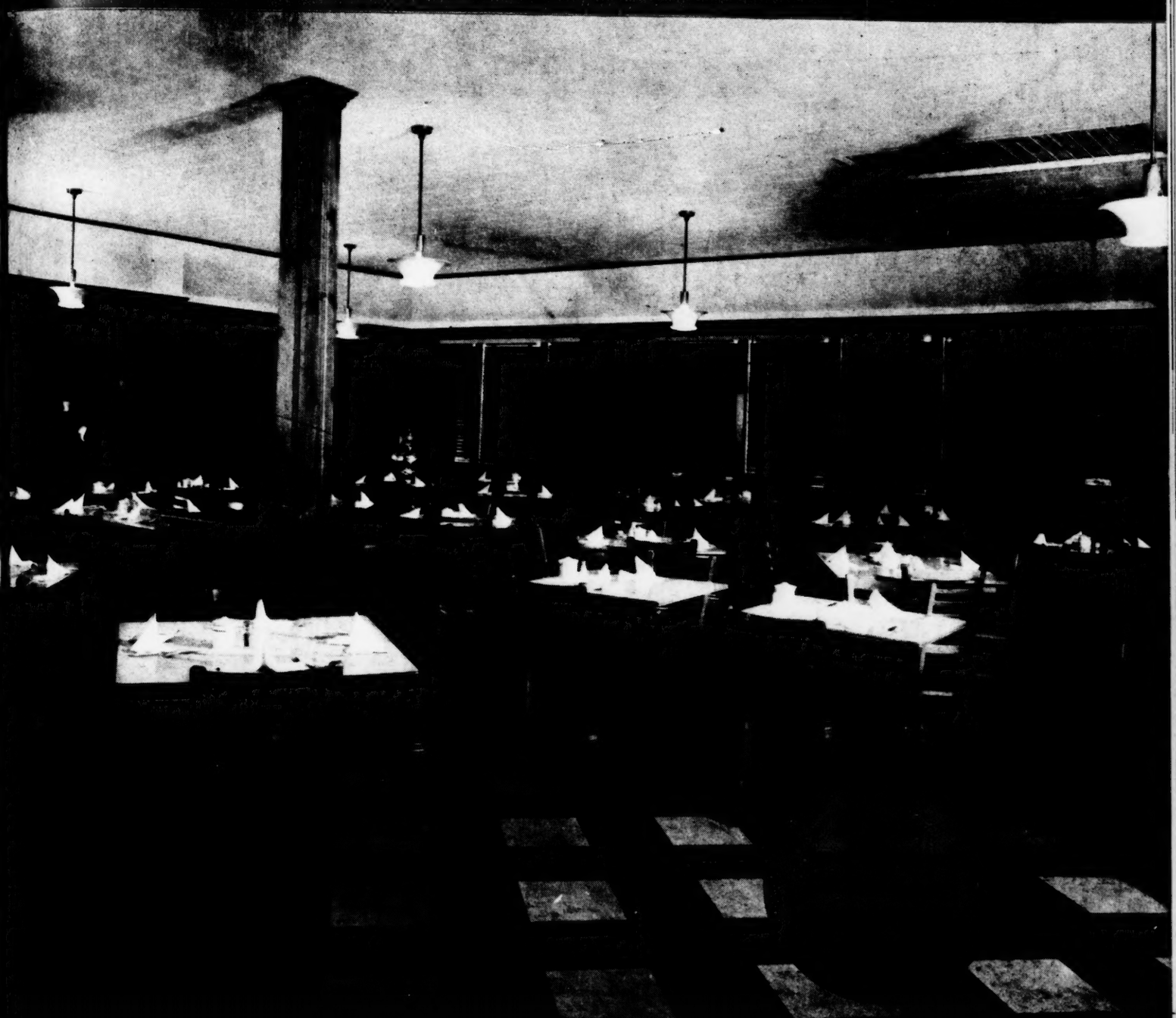

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Editor
CLIFFORD STROCK

Associate Editors
NATHAN N. WOLPERT
WILLIAM B. FOXHALL

Advertising Staff

Western Representative
GEORGE G. TURNER
228 North La Salle Street
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Eastern Representative
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148 Lafayette Street
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Los Angeles 5, Calif.

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THIS MONTH'S COVER

Multiple self-contained or packaged air conditioning units are installed in the Pig and Whistle Restaurant, Atlanta, Ga., as illustrated. For details regarding the use of multiple units see article on page 59. Photograph, courtesy of General Electric Co.

THE NEWEST in Air

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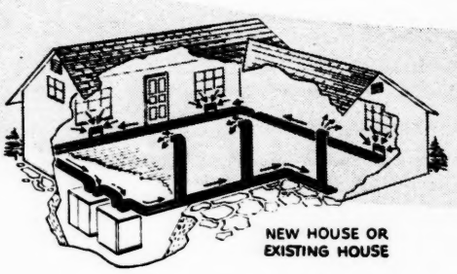

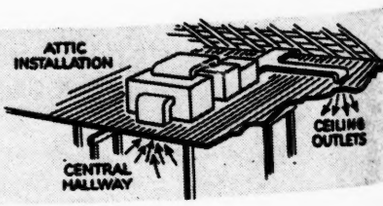

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Washington News

LORING F. OVERMAN

AT presstime for this column, Congress had virtually decided to yield to President Truman's request for a new slingshot—price-wage-materials control powers.

The House had passed a bill giving the President the right to use his new weapon on any target he might choose. The Senate placed greater limits upon permissible uses of the new but dangerous toy.

A conference committee was ironing out details, with quick action in both houses of Congress promised.

Senate Limitations

The Senate placed three important limitations upon Presidential powers:

(1) All authority over priorities and allocations would be vested exclusively in the Secretary of Commerce;

(2) The President would be required to come to Congress for funds to finance production expansion and purchase programs proposed under the bill; and

(3) His discretionary application of "selective" price and wage controls is prohibited. Instead, he would have to control prices and wages generally if at all, and he would be required to put curbs on wages if he attempted to control prices.

Powers Extensive

Despite certain limitations suggested by the Senate in an 85 to 3 vote, the measure would still give President Truman and his official family tremendous authority over the nation's economy. The words "official family" are used advisedly, for they serve to illustrate the fact that no matter what is done in Washington, or how it is done, it is certain to be criticized. For example, at the first hint of a new war-economy program, Washington was deluged with suggestions like this:

"If we must have controls, don't set up a lot of new WPB's and OPA's. Use existing government departments and personnel."

So as of this moment, controls designations would be as follows:

Food rationing and food price control—Agriculture Secretary Brannan;

Regulation of industry and war production, including industrial price control—Commerce Secretary Sawyer;

Oil, fuel, lumber and mineral controls, including rationing of gasoline and fuel oil—Interior Secretary Chapman;

Civilian defense and civilian health problems—Social Security Administrator Ewing.

Noting that placing such controls in the hands of this closely knit foursome would be tantamount to placing it in the hands of the President himself, many observers are now branding the proposals as purely political. So, as previously observed, you're criticized in Washington if you do use existing facilities, and castigated if you don't. So who's to blame a President for deciding to do it his way!

Loaded Gun

Although the President has repeatedly said that he needs only certain limited powers "for the present," it is quite likely that having a loaded weapon lying around may prompt someone in the "official family" to want to try it out to see if it will work. That price control authority, for example: Congressional leaders say that the President—whether he wants to or not—must soon impose price controls to keep down the prices of equipment needed by the armed services.

They point out that defense costs are staggering, and still climbing. The following are examples:

In 1939 a B-17 bomber cost $330,000; today $3,000,000. In 1939 a destroyer cost $7,000,000; today $40,000,000. In 1939 light tanks cost $27,000; today $225,000; in 1944, at the height of World War II, an infantry division could be equipped for $14,500,000. Same job today costs $74,000,000. Armed division equipment then cost $30,000,000; today $199,000,000.

So it is surmised that unless price controls are applied to the things the armed forces need, it will be necessary to raise taxes again before long. And if the conference committee accepts the Senate requirement that applying one price control requires application of all of them, with wage controls besides, it won't be long before the new slingshot is in use, probably with painful results.

Voluntary First

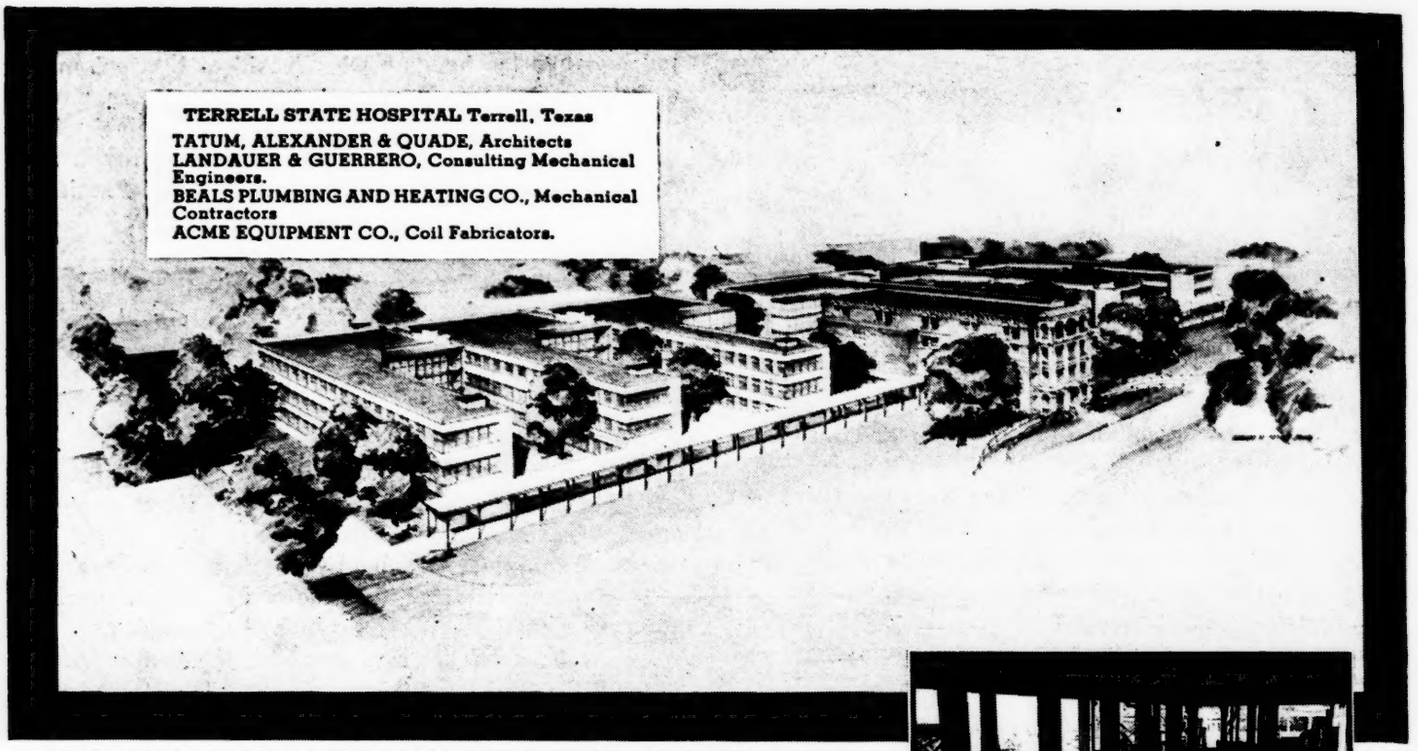
Senate version of price and wage control sections of the bill would authorize the President to first promote voluntary actions by business, agriculture, labor and consumers in holding down prices and wages. Any agreements reached by such voluntary methods would be exempt from prosecution under the anti-trust or Federal Trade Commission acts.

Should the President find that he cannot control inflation by voluntary methods he would be empowered to issue orders setting ceilings on the price of any material, service or property, with specified exceptions. If the President decided to put ceilings on prices, he would at the same time be required to prohibit increases in wages, salaries, or other compensation except when he deemed it necessary to approve increases "to prevent gross inequity or to effectuate the purposes of this act."

In fixing price and wage ceilings the President would have to give due consideration to the price and wage levels of the May 24-June 24, 1950 period. The bill permits a rollback to that period, with some exceptions. Wages could not be stabilized below those levels.

Powers Granted

Although the Senate version of the war production controls bill contained a number of restrictive provisions, the President's official family is still granted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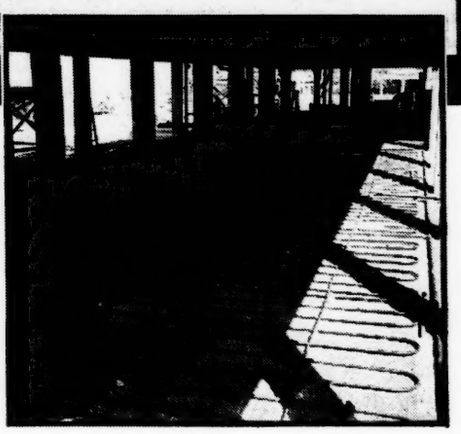

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The protection of wrought iron was also provided for three other vital services—steam supply lines; steam return lines; and interior down-spouts. Corrosion is always a threat in such lines, wrought iron has demonstrated its superior resistance by decades of trouble-free service.

The U. S. Public Health Service hospital program is doing a wonderful work in safeguarding the health of hundreds of communities. In any such construction, it is important to safeguard *pocket-books* as well, by the use of durable materials that require minimum maintenance.

You will find some helpful information on the use of wrought iron in radiant heating in our bulletin, "WROUGHT IRON FOR RADIANT HEATING INSTALLATIONS." We will be glad to send you a copy.

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full wartime powers. Through the Secretary of Commerce the President could allocate materials and facilities in practically any way he might decide would promote national defense. He could require business to give priority to Government contracts—even to the extent of requiring the acceptance of a contract whether the firm desired it or not.

The President could requisition for the Government's use any equipment, facilities, materials or supplies needed for defense or war. He would only have to exhaust all "reasonable efforts" before acquiring such items by force. He would also determine what "just compensation" would be.

The Senate bill also empowers the President to establish "such principles and procedures and to take such action as he deems appropriate toward the settlement of labor disputes affecting national defense."

The Federal Reserve Board would be empowered to control consumer credit under plans similar to that of Regulation W during the last war. Intended would be the limiting of consumer buying through regulation of installment loans made by banks. The Federal Reserve Board would also be authorized to fix loan terms for financing of new construction or reconstruction. Limits on construction loans would apply to all construction not begun before August 3, 1950.

Machinery Readied

Although the final form of defense production legislation was not known at presstime, its general outlines seemed fairly well fixed, and the Department of Commerce in particular was preparing to take over the expected assignment. Secretary Sawyer announced the appointment of William Henry Harrison to head the allocations and priorities division within the Department of Commerce. Mr. Harrison is president of the International Telephone and Telegraph Co.

Early in World War II Mr. Harrison was director of production for the War Production Board. Later he served as a major general and director of procurement for Army, receiving the distinguished service medal for his services in supplying communications equipment to all theaters of operation.

Materials Control

Although details have not been settled, it seems likely that Mr. Harrison will head a department which will operate somewhat like the Controlled Materials Plan during World War II. In some other respects, it would operate like the voluntary agreements program followed in postwar 1948 and 1949. Mr. Harrison's offices would accept claims for scarce materials from other agencies—Agriculture for farm equipment, Interior for mining and petroleum, Interstate Commerce Commission for transportation, and so on.

All claimant agencies, as well as the allocating group, would be represented on a Central Requirements Committee. That committee would balance all requests and supplies, and arrive at broad quotas for each consuming industry. Up to this point the plan would be similar to that of the last war. During that conflagration, however, it became necessary for strict allocation of supplies within industries. Such a strict priorities and allocation system is not contemplated at present; at least not unless more of an all-out stage is reached in hostilities. For the present, scarce materials would merely be earmarked by the Commerce Department, at the source, for essential industries, in quantities agreed upon by the Central Requirements Committee. Consumers not considered "essential" would not be included in the plan. They would have to scramble for any supplies remaining after the "essentials" had been served.

Referee Symington?

Because the Commerce Department will appear on the Central Requirements Committee as both a claimant organization and as an allocator, it is anticipated that Stuart Symington, head of the National Security Resources Board, will supervise the operation and exercise a veto power.

Although all this Washington machinery is being oiled up to take its place in the production and distribution economy, many hope and anticipate that a vast amount of voluntary work will be possible before it becomes necessary to clamp down in earnest.

That is a circumstance much to be desired, for it will mean that we are not completely at war; that we are meeting our defense commitments without having to yield to the wartime restrictions which have such a persistent way of remaining in effect long after the shooting has ended.

Effort to Pyramid

There is nothing on the horizon to indicate, however, that the coming defense program is going to be any business-as-usual operation. Washington is merely getting ready for come-what-may; watching the weathervanes and trying to estimate whether the defense program, as presently set up, is big enough to do the job. Currently, plans call for approximately $16.3 billion in addition to the $13 billion originally included for the military. Some have estimated that next year's program will require $40 billion or more.

With such a conception, it is anticipated that controls on steel, rubber and aluminum will be the first to require allocation. Controls would then be extended gradually to include copper, zinc, chemicals, building materials, and so on.

War Economy

If and when supplies tighten so much that both military and essential civilian requirements are not adequately met under industry-administered quotas, look out. War economy will be upon us 100%, and a long list of priority ratings will again give preference to such industries as oil, power, ship and transportation builders—after military needs have been met. In this latter stage would come forced cutbacks in all civilian industries using large quantities of scarce materials, or easily convertible to war production.

During the period when the Washington finger will be on the production pulse, the new Department of Commerce allocation bureau will proceed on a flexible basis. Career men within the department will build the framework and have the system ready for quick expansion in the event of actual need.

BRIEFLY STATED

• Top executives of the steel industry, trying to allay the fears of their customers, have been stating in recent weeks that the industry will be able to furnish all the steel needed for military production and still be able to provide enough for high-level civilian production. Backing up those statements, the American Iron and Steel Institute said that finished steel made from twenty-four hours of full output of raw steel would provide steel every day for all of the following items (average size): an aircraft carrier, 500 airplanes, 1,000 anti-aircraft guns, 500 tanks, 500,000 three-inch shells, 1,000 howitzers, 2,000 aerial bombs, two heavy cruisers, 1,000 freight cars, 2,000 trucks, two cargo ships, two tankers, 12,000 automobiles, 2,000 homes, 20,000 household refrigerators and 20,000 stoves. And after all that, more than 20,000 tons of steel would remain for other purposes, according to the Institute. It was pointed out further that the domestic steel industry can now provide 2,240 pounds of steel for every 2,000 pounds needed when World War II was at its height.

• Total sales of gas by utilities to ultimate customers in June, 1950, were 2.9 billion therms, an increase of 18.3% over 2.5 billion therms sold in June 1949, the American Gas Association reported. For the twelve months ended June 30, 1950, total sales of gas showed a gain of 11.9% compared with the comparable period a year earlier.

• How big the typical FHA apartment is and what it rents for was answered by Commissioner Franklin D. Richards when he announced the results of the annual analysis of rental project commitments issued by FHA field offices during 1949. Rental project commitments in 1949 covered 170,000 units, almost entirely under Section 608, of which 58% were of the walk-up type, 27% in elevator structures, 11% in row houses, and 4% in semi-detached units. The typical apartment in FHA rental projects approved for mortgage insurance in 1949 was a four-room unit with a monthly rental of about $82.50.

• The largest contract ever placed for home heating equipment, calling for the installation of 18,186 dual floor furnaces in the homes of the gigantic Lakewood Village housing development in Los Angeles County, was signed recently. The amount involved in the contract is $1.5 million. Installation of the furnaces will require approximately nine months. Lakewood Village is the largest project of its kind in the world. The furnaces were supplied by the U. S. Grant Supply Co. through its dealer, Paramount Heating and Air Conditioning. Johnston Gas Furnace Company of North Hollywood is the manufacturer.

• The 7th All-Industry Refrigeration and Air Conditioning Exposition to be held at Navy Pier, Chicago, November 1951 will be a 4-day show instead of a 5-day show as originally planned. Dates of the exposition will be November 5, 6, 7 and 8, 1951, with no special days or previews.

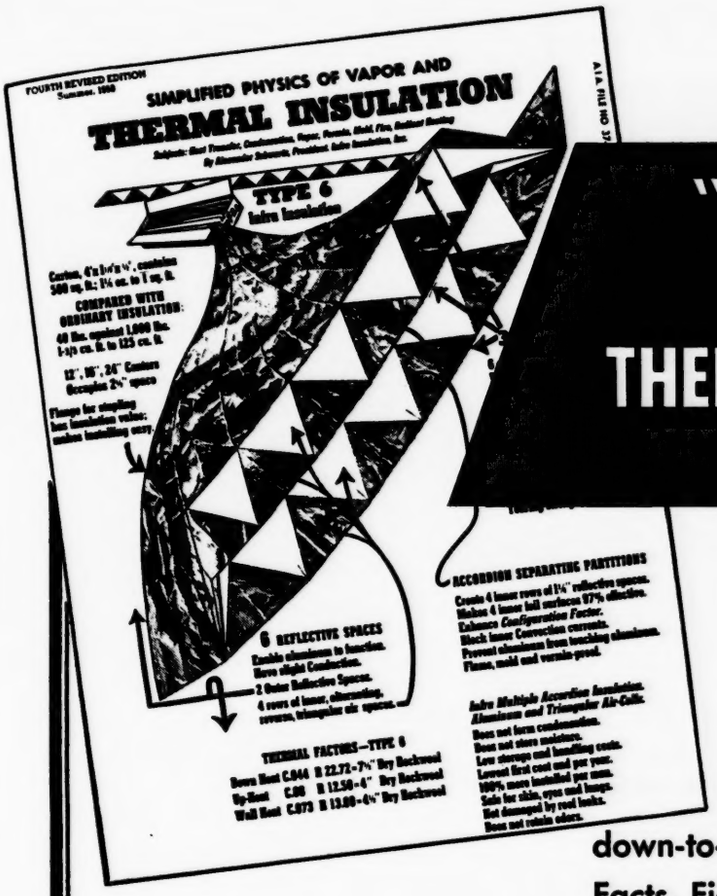
• Reservations of capital grant funds under the HHFA Slum Clearance and Urban Redevelopment program have been made on proposed slum clearance projects for 201 localities in the continental United States and insular possessions. These reservations as of Aug. 1, 1950 total $162,898,023. Biggest reservation since June 23 was $2.5 million for Kansas City, Mo.

• Development of a composite administrative and regulatory code to include a building code, an electrical code, a plumbing code and a demolition ordinance is to be undertaken by York, Pa., with the technical assistance and advice of HHFA, Administrator Raymond M. Foley of the Housing and Home Finance Agency has announced. He emphasized that this was a special purpose project for the development of needed information on codes and regulations and that the HHFA could not undertake to render such extensive assistance to cities generally.

• An experimental prefabricated house differing considerably in structural design from other prefab units, was recently built by Pierce Foundation at Lebanon, N. J. The framework, comprised of a series of trusses or bents, is tipped up, fastened together and to the foundation before the walls are erected. Roof sheathing panels are nailed to the trusses as soon as the frame is erected. Before the exterior wall panels are installed, the ceiling is put up. Then the wall panels, nominally 8 by 7 ft, and set between columns which have mastic applied to them, are tipped up. Machine-driven screws go diagonally through the columns into the framing of the panel, pulling the panel tightly into place against the column and squeezing the mastic between joints and adjacent panels. The panels are double-faced, stressed-skin plywood construction of 3½-inch wood framing, with ⅜-inch exterior grade plywood and a ¼-inch inner skin. Panels are insulated with blanket-type material having one face covered with reflective aluminum foil.

• Lester T. Avery, of Cleveland, president of the American Society of Heating and Ventilating Engineers, announced the election of eight life members of the society. The leaders in the field of heating, ventilating and air conditioning thus honored are: L. L. Anthes, Toronto, Ontario, Canada; H. P. Gant, Glenmore, Pa.; William McClintock, New York City; L. Walter Moon, St. Louis, Mo.; Robert M. Rosebrough, Webster Groves, Mo.; J. O. Ross, New York City; Alfred E. Stacey, Jr., Syracuse, N. Y., and Walter G. W. Turno, East Orange, N. J.

• During the first nine months of this year, permits for building construction valued at $619 million were issued by New York State urban communities, according to Acting Industrial Commissioner Thomas F. Moore, Jr. Residential building accounted for $396 million, nonresidential building for $168 million; additions, alterations and repairs for $55 million. (Urban communities are those with at least 2,500 population.) Dollar volume was up $209 million (51%) over the corresponding period in 1948, due in part to an increase of $125 million in public housing construction in New York City.



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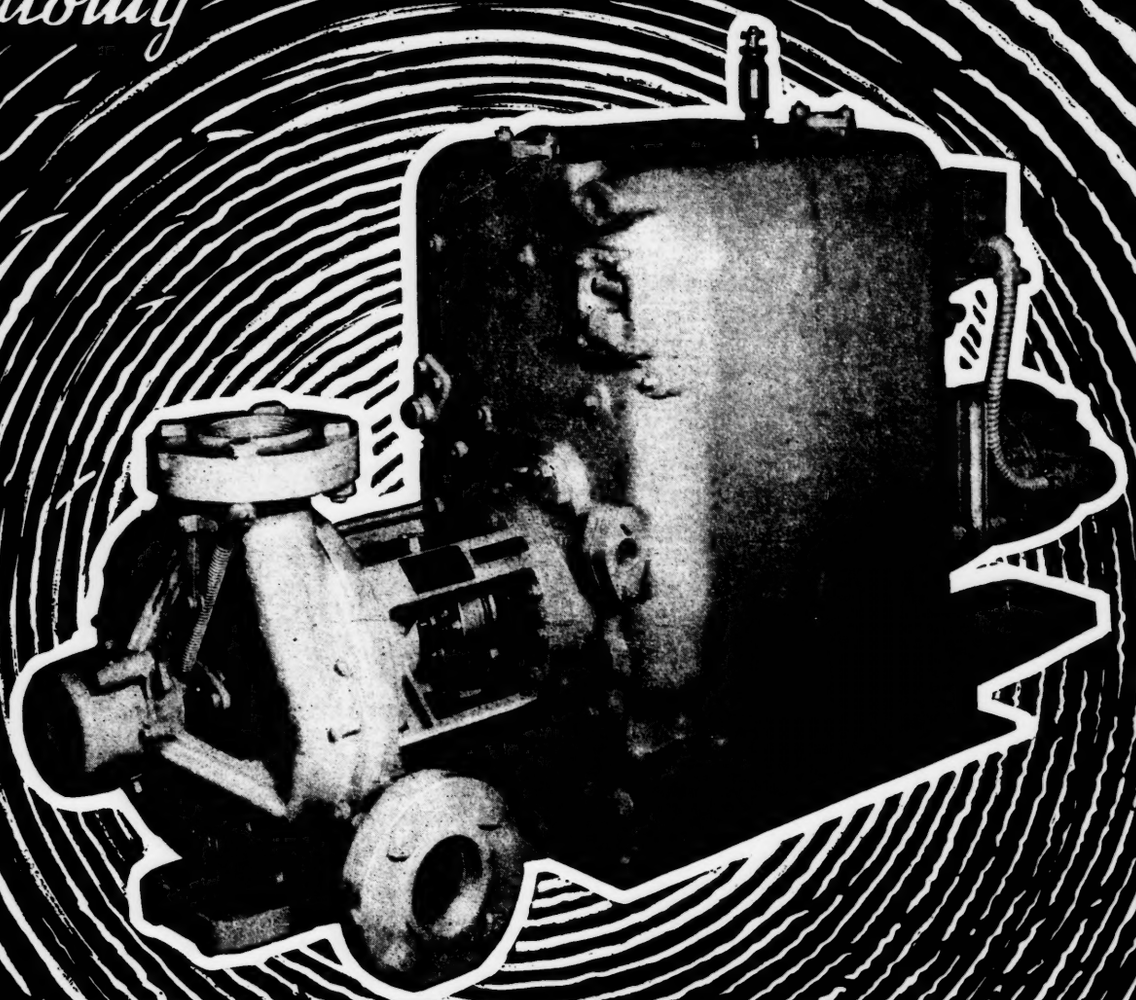

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THE NASH ENGINEERING COMPANY
SOUTH NORWALK, CONNECTICUT, U. S. A.

Multiple Installation of Self-Contained Air Conditioners

Grilles in a partition wall of the fur department of Ernst Kern Co., Detroit, Mich.

C. M. toeLaer

Commercial Engineer, Air Conditioning Department, General Electric Co., Bloomfield, N. J.

While single packaged air conditioning units have been used for stores and offices of small area, multiple units are now serving places of large area, such as department stores and office buildings. Article discusses the installation of multiple units for such applications.

CENTRAL plant air conditioning systems have always been quite prevalent in the larger stores. However, any proposed air conditioning job with a cooling load of 10 tons or more can possibly lend itself better to packaged air conditioners in multiple than any other method of cooling.

This article considers large retail store applications and the use of packaged units in large office buildings, as contrasted to a previous article (H & V, June 1950, pp 75-86) which covered applications in small stores.

Multiple installation of packaged air conditioners has been successful, among others, in the following installations: Airline offices, airport administration buildings, apartments, auditoriums, banks, bars, billiard halls, bowling alleys, bus stations, cafes, cafeterias, clinics, clothing stores, clubs, coffee shops, factories, florist shops, funeral homes, grocery stores, hospitals, hotels, industrial plants, libraries, railroad terminals, residences, restaurants, schools, studios, super markets, and theaters.

Engineers have been accustomed to thinking of packaged air conditioning units as a means of air conditioning relatively small areas, such as retail stores, single rooms, and offices. The next step forward was the use of remote room air conditioners with only small water and drain pipes and perhaps a ventilation air duct with a chilled water cooling system for the entire building located at a central remote location. With this type unit, zoning became greatly simplified. Installed cost dropped, less valuable floor space was consumed, and better air conditioning resulted.

Comparison of Acceptable Methods

Packaged units offer most of the advantages of the remote units and many additional advantages. Table 1 attempts to evaluate the three accepted methods of air conditioning large areas—with *A* being the most favorable for the particular point being considered, *B* second, and *C* the least desirable. Having worked on the

TABLE 1—GRADING OF THREE TYPES OF AIR CONDITIONING SYSTEMS

Item	Packaged Units	Remote Room Air Conditioners	Central Plant System (Air Ducts)
Overall Building Space Requirements	A	B	C
Rentable Space Utilization	B	A	C
Room Floor Space Requirements	C	B	A
Appearance	C	B	A
Installation Cost	A	B	C
Disturbance to Customers During Installation	A	B	C
Simplicity of Control	A	B	C
Simplicity of Zoning	A	B	C
Operating Cost	A	B	C
Flexibility with Changing Tenants—Partition Changes and Usage	B	A	C
Quietness of Operation	C	B	A
Simplicity of Installation	A	B	C
Possibility of Operating Cost Paid by Tenant	A	B	C
Adaptability of Gradual Pay-As-You-Go Installations (One Area at a Time)	A	B	C
Localized Fresh Air Control	B	A	C
Adaptability to Shifting Hourly Occupancy Loads	A	B	C
Spring and Fall Flexibility	A*	A*	C
System Application Engineering Requirements	B*	B*	B*

*Grading considered to be of equal value.

design of all three types of systems, the author considers Table 1 to be unbiased.

It is understood that controls are readily available for the remote room units which make possible automatic individual room zoning. With central plant systems, automatic dampers operated by thermostats located in the individual rooms may be readily installed.

Table 1 is based on the most common control schemes employed today in each of the listed methods of air conditioning, and many of the points listed in this table are discussed.

Trends

Methods of air conditioning areas must change as building construction trends change. Owners of old office buildings are faced with the problem of reduced occupancy if they are to obtain favorable per square foot rentals. Air conditioning the building often reduces rentable space by as much as 10%, and this loss of space can be justified as occupancy and rental income remain high. It is far better to utilize a portion of the rental space and maintain full occupancy rather than to maintain 50% occupancy and the lower rentals which otherwise might result. Packaged units consume a small amount of rentable space and have the lowest installed cost.

Air conditioning systems tend to follow building construction changes. The greatest use, of course, is for modernization work where major cutting and patching would otherwise result.

These trends in building construction are bound to have a major effect on the type air conditioning systems to be installed. Packaged units in all probability will be a major contender in the future market in new buildings, just as they are today in the modernization market, as indicated by the installations discussed.

Some air conditioning contractors are anxious to try this system because they feel little or no engineering is necessary. The erroneous impression has been created in some areas that this type system is apt not to be as good because so little engineering is required.

However, multiple packaged air conditioning systems require just as competent an engineer as any of the other types discussed. The overall cooling load is important regardless of the system installed. Computing localized load conditions, air distribution, and unit sizes may consume as much or more time than the sizing of the ducts and central plant on a central air distribution system, or selecting the room units and the central plant that is required for a remote room air conditioner application.

In engineering the job, many points are simplified by the complete flexibility and adaptability of packaged air conditioners. The refrigerant cycle engineering is done by the manufacturer; the application is the only engineering required by the installing contractor.

Packaged or self-contained units are available from most manufacturers in 2, 3, 5, 7½, and 10-ton sizes. This makes it possible to use units of the size required to effectively zone the system. Rooms on a given floor with one side exposed on the same side of the building and the same shading effects from adjoining buildings may be connected to a single unit—perhaps a 10-ton unit. Corner rooms may require a 2-ton unit serving an entirely separate zone.

In the case of conference rooms or executive offices, it may be desirable to zone them with adjoining offices of more constant occupancy and to supplement the short duration occupancy rooms with window units operated by a room thermostat set somewhat above the zone thermostat setting. As an alternate, of course, manual control can be used on the window air conditioners.

Even in large open areas, such as are found in department stores, it is well to carefully sectionalize the areas, making separate heat gain calculations for each section. Units must be so placed as to give uniform air circulation and temperature distribution. This can only be accomplished by matching the units to the load in the area they are to serve.

Typical Installations

One of the early successful installations of packaged air conditioners in large retail stores was that in Himelhoch Bros. & Co., a women's apparel store in Detroit, Mich., Fig. 1. Packaged units, which were installed prior to the 1941 cooling season were decided upon for the following reasons:

(1) A central plant system could not have been ready for the 1941 cooling season.
(2) A unit system would be flexible enough to permit installation of first, a test application, then installation by floors as desired, with business being transacted all the while.
(3) First cost with an expensive central plant system, with accompanying store remodeling to provide proper distribution, would be higher than the unit system.
(4) Operation of the units could be undertaken successfully by the store's own maintenance department.

Twelve General Electric 3- and 5-ton units were installed at various points throughout the store. Comfortable circulation was provided the first year by the units themselves aided by a few carefully located oscillating fans. Standard control of the air distribution and the units was accomplished with the standard louvers at the top of the unit. Uniform cooling was assured by operating each unit from its own thermostat. There were as many zones as there were units.

Adequate temperature and moisture reduction were provided with actually less capacity than was called for by preliminary engineering calculations. This may be attributed to: (1) the absence of ducts, which means the elimination of duct losses; and (2) cooling air is discharged nearer the working level than if ceiling mounted ducts were used.

The following season, 6 more GE 5-ton packaged air conditioners were installed. Now that the installation is complete there are 45 packaged air conditioners installed, totalling 217.5 tons.

Accurate power and water usage data on the installation were taken for the 1949 cooling season. From a water and power consumption standpoint, the months of June, July, August, and September represent 82% of the total operating cost. During this period the store is open 6 full days a week and one evening until 9 p.m., for a total of 103 working days. During this period, power costs for the air conditioning system were about $0.10 per day per ton of installed capacity.

Water cost, the same four months, that could be charged to the air conditioning system, amounted to about $0.05 per day per ton of installed capacity. This includes sewerage tax and the charge for the water meters. The extreme operating economy is evident from the total operating cost—$0.15 per day per ton installed. It is quite common to find central plant systems operating at twice this figure.

Fig. 1. One of the many packaged units installed in Himelhoch Bros. & Co., Detroit, Mich.

Fig. 2. Packaged unit serves an appliance department.

Another interesting figure is the combined power and water consumption for the season related to floor area. For the 1949 season, the actual operating cost amounted to approximately five cents per square foot of floor area per season. Amortization of the equipment and installation costs showed another definite saving as compared with that for a central plant system. The success of the Himelhoch installation is best measured by the other stores that followed this lead. The Ernst Kern Co., one of Detroit's leading department stores, has recently installed 17 5-ton packaged air conditioners on the fifth floor—an area of 28,000 sq ft devoted largely to ladies' apparel.

The units were placed carefully to provide cooling capacity equal to the heat gain in the area in which the unit was installed. When required, ductwork was used, although most of the units discharge directly into the room as shown in Fig. 2, the major appliance showroom. A view of the grille locations in the fur department of the Ernst Kern Co. store is shown on page 59.

During a recent study, readings were taken at over 30 points in the conditioned area. All temperatures, but one, were within one degree of each other. It also showed that temperatures could be maintained 3 to 5F below indoor design conditions. These figures seem to show that somewhat lower capacity is required than the load calculations indicate. This may be attributed, in part, to the lower level at which the air is delivered, resulting in less mixing with the hot air at the ceiling. Elimination of duct losses also reduces somewhat the capacity requirements.

Management's satisfaction with results obtained on the fifth floor prompted use of packaged air conditioners on another floor in the building. With this type system more areas can be added as desired and on a "pay-as-you-go" basis.

In a department store, an air conditioning system must be completely flexible and semi-portable to allow for major redecoration, modified floor layouts, or a complete shift in items carried in the area. This, of

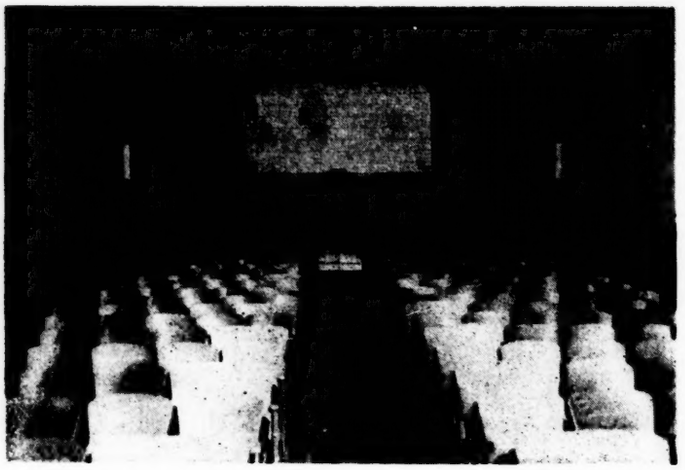

Fig. 3. Typical installation in a small theater.

course, is one of the major advantages in a packaged air conditioner system.

When a cooling tower is used with a multiple system of packaged air conditioners, it is often advisable to equip each unit with a water-regulating valve to limit the flow. This is a desirable feature during mild weather operation when only a few units are operating. Low temperature cooling tower water, without the use of water-regulating valves, would cause abnormally low head pressure, tending to result in the cycling of the unit on the back pressure switch. To insure operation with fairly uniform pressure on the discharge side of the pump (the inlet to the packaged air conditioner condenser), by-pass lines with suitable relief valves should be installed between the supply and return risers. These valves open on increased pump pressure and by-pass water to the cooling tower.

Other Applications

In some cases it will be found desirable to use remote room air conditioners for portions of the building and packaged units for the balance. A typical example of this is a system where the outside walls (periphery) have the central plant chilled water system and the interior areas are conditioned by packaged units.

Another feasible combination system would provide a central plant duct system for the basement and lower floors, packaged units on the intermediate floors and a chilled water system in the tower.

The portability and flexibility of packaged units indicate a definite adaptability to rental space where the tenant can at his own expense make the installation and also retain the property right to it. Such units, can either be on a metered city water basis or employ water from a cooling tower installed by the building management. If ductwork is not installed or if the unit is not built in, the tenant may generally take it with him when he vacates the property. In this way, at a minimum expense to the building owner, those tenants who desire air conditioning may be provided the comfort without making a permanent improvement to the property or be forced to take complete depreciation when they move.

Although this article concentrates on large retail stores, it should be remembered that multiple installations are equally adaptable to other types of buildings. The short duration peak loads in restaurants, for example, have been well handled by multiple packaged installations. The cover photo shows a typical restaurant installation. Fig. 3 shows a small motion picture theater in Louisville, Ky., where four packaged air conditioners were installed. Each unit is equipped with a fresh air duct to provide ventilation air. The fans may be used for between-season operation when neither heating nor cooling is needed to take full advantage of the outdoor air temperature.

Fresh air should be considered carefully in the design of the air conditioning for any large system. In some applications the engineer may decide to rely on natural infiltration. In some cases, however, this will not be adequate and other provisions must be made. The use of one large packaged unit may be used for ventilation air only to meet the full building requirements. In such case, a freeze-resisting steam coil or antifreeze in a water coil may be required if heating will also be handled by the packaged units. Where a small quantity of fresh air is required, the consulting engineer may decide to bring it in through one or only a portion of the units. The balance of the units will then handle only recirculation air. If the units are to provide ventilation air in the winter time in climates where the lowest recorded temperature is below —20F, less than 30% fresh air must be provided on a single unit or freeze-resistant steam coils must be used.

Regardless of the method of introduction, the ventilation air quantity should be selected to meet the job requirements. About 20 to 30% ventilation air is usually adequate for the cooling season. The ventilation air intake should be located on a cool, clean, and odor-free side of the building. Adequate screening to prevent birds and insects from entering, and rain protection are required. Where practical it is desirable to bring in a portion of the fresh air requirements through each of the installed units. This is particularly true in installations where heavy smoking is anticipated.

There are a great many points to be considered in the design of a multiple system. Careful engineering overcomes these obstacles and makes for a most satisfactory installation. Knowledge of the quality performance that accompanies a multiple packaged system encourages contractors who have made one installation to seek out new and different multiple applications. The field is a lucrative and nearly unlimited one and should be investigated fully by progressive air conditioning contractors. The contractor will benefit himself and will make available to the owner a system at a lower installed cost and one that has in numerous installations proved to have a lower operating cost.

No large air conditioning system installation should be undertaken without the counsel of a competent consulting engineer. This applies to installations employing packaged air conditioners just as it does to a large central plant or remote room air conditioner installation. The future of this rapidly growing market is contingent on the adequacy of the design and the competency of the personnel that will be responsible for the installation.

Behavior of Radiant Heated Hardwood Floors

J. S. MATHEWSON

Engineer, Forest Products Laboratory[1], Forest Service
U. S. Department of Agriculture

Observations on the behavior of hardwood flooring laid over heating pipes embedded in concrete and over others supported on wood joists showed that drying during the winter sometimes caused objectionable cracks between flooring strips and that absorption of moisture during the summer sometimes caused the floor to buckle. Recommendations are made for minimizing both shrinking and swelling.

A RAPID increase in the use of radiant heating in the last several years has sometimes been accompanied by abnormal swelling and shrinking of wood floors laid over radiant-heating pipes. Although it is not within the province of the Forest Products Laboratory to give advice that other competent engineers can give about the kind of heating system to install in buildings, it is a function of the Laboratory to work out construction methods by which wood will give satisfactory service in buildings with all kinds of heating systems.

For dwellings with conventional types of heating systems in most parts of this country, the usual recommendation is that hardwood flooring be installed at a moisture content of 7 to 8%, or about midway between its moisture content in summer and in winter, in order to minimize the shrinking that causes unsightly cracks during the winter and the swelling that causes buckling during the summer. Fig. 1 shows average moisture content of hardwood flooring recommended in U. S. regions for installation with conventional heating systems.

It is probable that in a dwelling with radiant heating the wood flooring will attain about the same maximum moisture content in summer as it would with conventional heating. Because of the closeness of the flooring to the pipes in radiant heating, however, its moisture content in winter is likely to be lower than it would be with conventional heating, so that it will be more difficult to avoid buckling or cracks between floor boards.

General Applications

With a view to preventing cracks or buckling in floors laid over radiant-heating pipes, visits were made by a member of the Forest Products Laboratory staff to manufacturers of equipment and to occupants of dwellings to obtain essential information on their experience with radiant-heating systems. On the basis of this information a radiant-heating test unit was installed at the Laboratory.

While radiant-heating coils may be installed in floor, ceiling, or wall, this report relates only to floor installations. The coils may be installed below, in, or on top of concrete floor slabs. In the cases observed, the coils were embedded in the concrete, and random-width or strip flooring was laid over the concrete. The flooring was nailed or screwed to sleepers (2 by 4 inches) either anchored or unanchored to the concrete.

With wood construction, the coils may be supported transversely on the top or bottom edges of joists or between and parallel to them. If the coils are above the joists, sleepers may be laid parallel to and between the pipes to support a finish floor with or without a subfloor; if below, furring strips may be applied to support a ceiling.

Case Histories

Behavior of wood floors laid over radiant-heating pipes can be described best perhaps by citing typical examples.

[1]Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

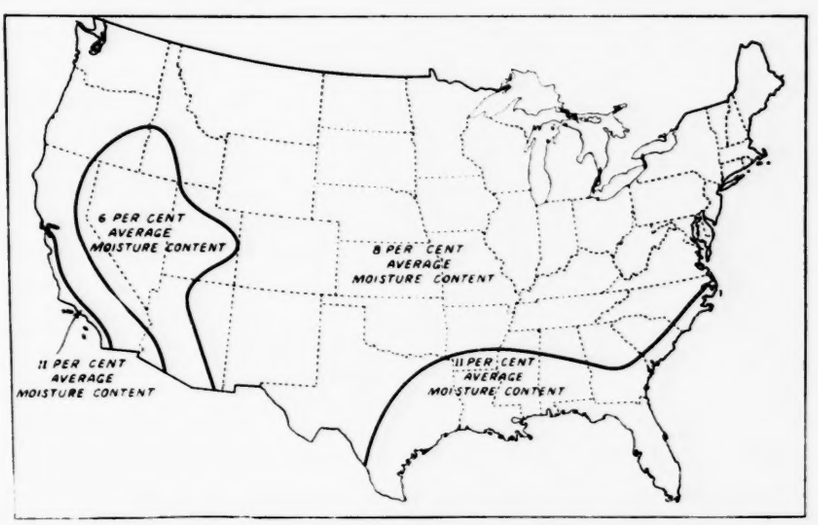
6 PER CENT AVERAGE MOISTURE CONTENT
8 PER CENT AVERAGE MOISTURE CONTENT
11 PER CENT AVERAGE MOISTURE CONTENT
11 PER CENT AVERAGE MOISTURE CONTENT

Fig. 1. Average moisture content recommended for interior woodwork in various regions. For hardwood floors laid over radiant heating coils, values will be about 2% lower than those shown on the map.

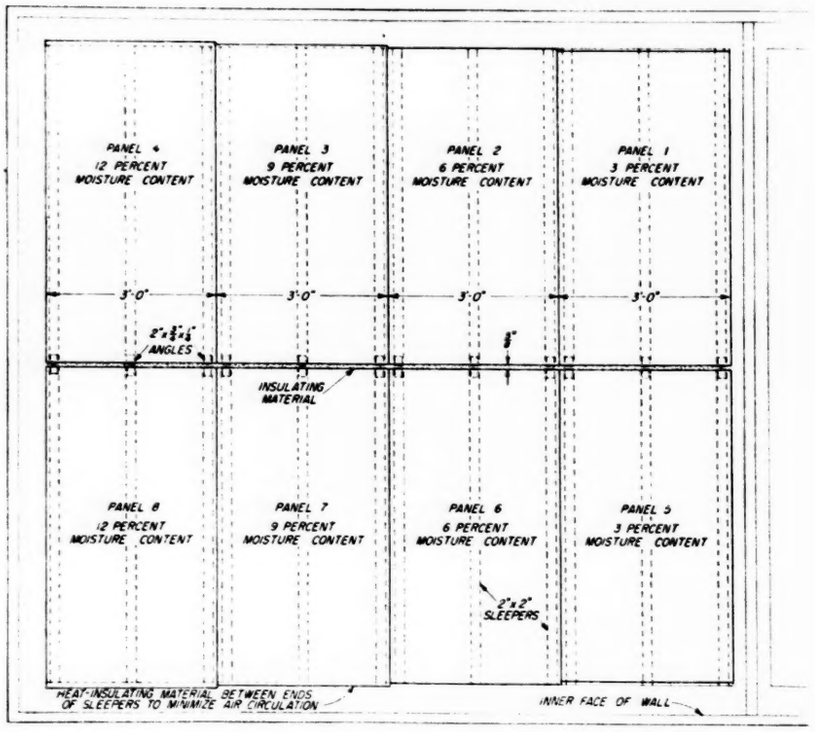

Fig. 2. Diagram of eight red oak strip flooring panels nailed to sleepers anchored to a concrete floor slab in which radiant-heating pipes are embedded.

In one new dwelling, the heating pipes were embedded in a concrete floor slab. Random-width oak flooring was nailed to 2- by 4-inch wood sleepers spaced about 16 inches apart and not anchored to the concrete. The owner moved into this dwelling on September 15, 1946, and the heat was turned on about three weeks later. A flooring inspector reported that the floor began to buckle soon after the heat was turned on, and that the buckling reached a maximum on November 26, 1946. By that date the floor had buckled up about 6 inches between the living room and the dining room. When observed on December 11, 1946, the floor, although it showed some cupping, was practically flat and had many cracks 1/16- to ⅛-inch wide and a few ¼-inch wide. The evidence indicated that the floor had become set in compression caused by its swelling with absorbed moisture, so that its drying caused wide cracks, especially between boards 5 to 7 inches wide, from shrinkage to less than the compressed width.

In a second new dwelling, which was completed in April 1946, 25/32- by 2¼-inch oak strip flooring was nailed to 2- by 4-inch sleepers that were not anchored to the concrete floor slab in which the heating pipes were embedded. It was reported that the concrete slab was wet from rain before the floor was laid and that the floor had buckled within a week after it was laid. When observed on December 14, 1946, the floor was very "wavy" over its entire area. A few boards were slightly cupped. Although one-half inch had been sawed off the lower edge of a door, it would not close properly. In this case it appeared that the presence of an abnormal quantity of moisture had prevented the floor from remaining flat.

In a third dwelling, about 10 years old, heating pipes were installed beneath wood joists in June 1946. The original random-width oak floor boards, 3 to 7 inches wide, which had been "pegged" to the subfloor, were in very good condition on December 14, 1946.

In a fourth dwelling, about five years old, heating pipes were supported on the lower edges of the floor joists, which were about 30 inches above the ground. Duplex paper painted with aluminum (foil was not available) was used just beneath the heating pipes by the owner to reduce heat loss to the space below the floor. It probably also reduced the moisture movement from the ground to the floor. The radiant-heating system was used for the first time in the fall of 1946. The 25/32- by 2¼-inch floor boards were in very good condition on December 14, 1946.

In a fifth dwelling, about 14 months old, the heating pipes were supported on the lower edges of wood joists above a basement. The 25/32- by 2¼-inch oak floor was nailed to the joists and was covered with a heavy

Fig. 3. Adjacent panels differing in width about ½ inch because of difference of 3% in moisture content.

carpet except in the closets, where several 1/16- to ⅛-inch cracks were seen. The owner said that some of the floor boards had been stored in the basement. It is possible, therefore, that the cracks resulted from the absorption of moisture in the basement and the subsequent loss of moisture after the heat was turned on.

What Causes Buckling

Observations made during the past several years indicate that the abnormal moisture absorption that causes buckling in wood floors laid over radiant-heating pipes is induced under the following conditions:

(1) Condensation of moisture may have occurred on a concrete floor slab on the ground when cool weather is followed by warm, humid weather. In one instance, well water at 55F possibly increased condensation on the concrete when the water was put into the heating system.

(2) The wood floor may have been laid before the water used in making the concrete was evaporated.

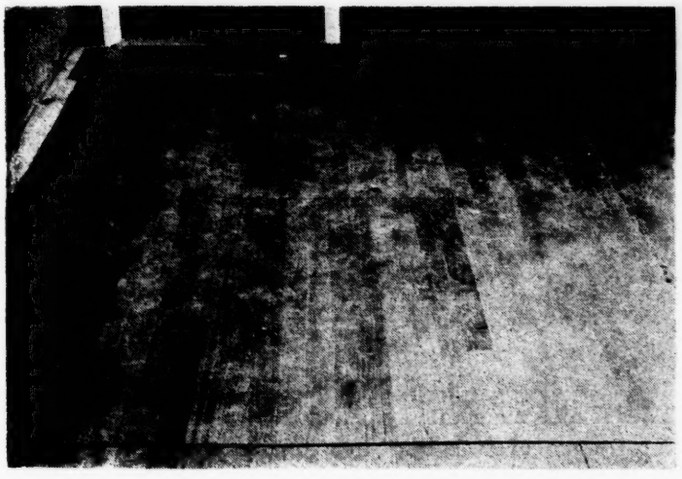

Fig. 4. Panels 1 and 2, with initial moisture-content values of 3 and 6%, respectively. Panel 2 is in foreground.

(3) Moisture from the ground may have passed through the concrete to the wood floor.

(4) In one case it appeared probable that rain had been blown through openings between the fascia board and the molding near the top of brick walls or around window frames, especially where gutters and downspouts were not used.

As pointed out previously, the absorption of moisture may cause the floor to buckle and compress, so that redrying may cause unsightly cracks between the floor boards. Cracks also may result if the boards are laid at too high a moisture content and are subsequently dried.

Experimental Work

The foregoing observations led to the installation of 1-inch hot-water heating pipes spaced about 10 inches apart and 1¼ inches below the surface of a concrete floor in a 12- by 15-ft room of a panel-exposure test unit built by the Forest Products Laboratory in 1947.

Below the 4-inch concrete floor slab was a 6-inch layer of pea gravel resting on a double layer of 30-pound roofing felt mopped down with hot asphalt and in contact with the ground. The purposes of this membrane were: (1) to reduce the possibility of the diffusion of moisture from the ground to the wood floor, since such moisture might cause the wood to buckle; and (2) to reduce the possibility that such moisture might increase the heat loss through the concrete and gravel to the ground. A 1-inch thickness of heat-insulating material that separated the foundation walls from the gravel and the floor slab decreased the transmission of heat from the slab and gravel to the foundation.

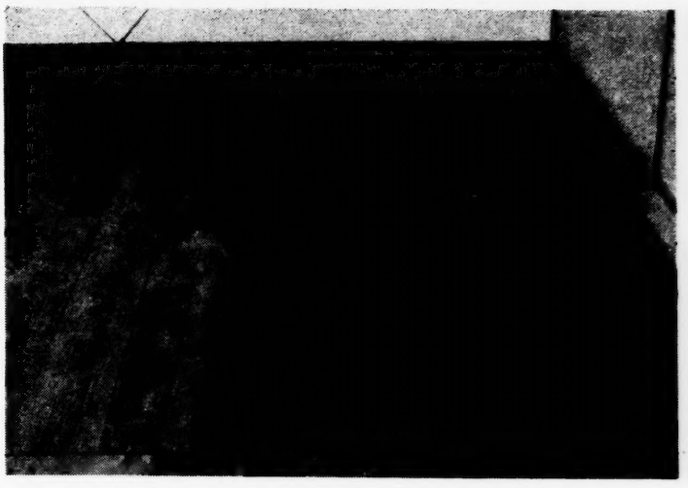

Fig. 5. Cracks in panels 3 and 4, with initial moisture-content values of 9 and 12%, respectively. Panel 3 is in foreground.

Clear 25/32- by 2¼-inch oak flooring strips in four groups having respective initial moisture-content values of 3, 6, 9, and 12% were nailed to 2- by 2-inch sleepers anchored to the concrete. Each panel was made up of a group of 29 flooring strips. The panels averaged 36 by 65.4 inches in area, with the strips laid so that their width totaled the length of the panel (Fig. 2). The flat-sawed panels differed in width by approximately ½ inch for each 3% difference in moisture content (Fig. 3). The groups in one-half of the floor were essentially flat-sawed, while the others were essentially quarter-sawed. The flooring was laid November 12, 1947, and two coats of sealer and one coat of wax were applied during the next 5 days.

In an adjoining utility room, a 6-kilowatt unit heated the water that was continuously circulated through the coils by a 1¼-inch pump. An outdoor thermostat controlled the water temperature so that it rose or dropped, respectively, as the outdoor temperature became lower or higher.

A modulating thermostat in the test room controlled the setting of a three-way valve in such a way that all the water could be circulated through the electric heater, or part or all of it could be by-passed around the heater.

The controls for an electrically operated humidifier were arranged so as to maintain a relative humidity of 40% in the room air during cold weather unless moisture would condense on the inside pane of a window protected with storm sash. Ordinarily, the relative humidity varied beween 35 and 45% during the heating season.

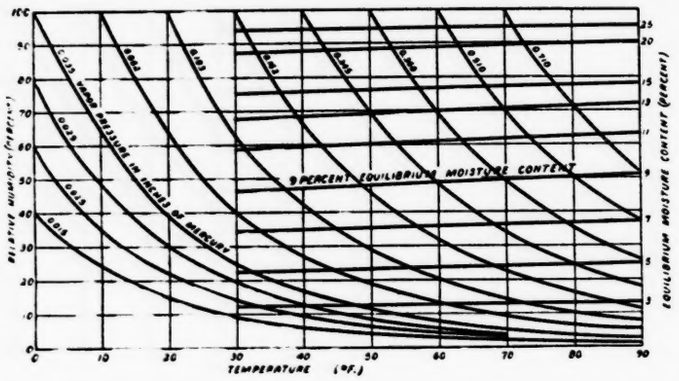

Fig. 6. Relationship of relative humidity, vapor pressure, equilibrium moisture content, and temperature for determining amount of heat required for lumber storage under various conditions.

Temperature readings were taken with a portable potentiometer on the upper surface of the wood floor. A gas-filled instrument was used to record the room temperature and the outdoor temperature. Mercurial thermometers were used in determining the temperatures of the water entering the coils embedded in the concrete.

To maintain a room temperature of 72F the temperature of the water varied from 95F, with an outdoor temperature of 36F, to 160F with an outdoor temperature of 0F. The corresponding average floor-surface temperatures were 74 and 90F.

Behavior of Floor Panels

Strip-width totals of panels changed by amounts that depended upon the initial moisture-content values and upon whether the flooring strips were essentially flat-sawed or quarter-sawed. Panels 1 and 5, with an initial moisture content in November 1947, of 3%, absorbed moisture and swelled more than any of the other panels during both winter and summer. By September 17, 1948, panel 1 had swelled 0.57 inch and panel 5 only 0.39 inch. The difference may be accounted for by the fact that panel 1 was essentially flat-sawed, while panel 5 was essentially quarter-sawed. As a result of swelling, panel 1 had buckled up about one-quarter inch by September 17, 1948. Drying and shrinking during the following winter caused the buckling to decrease to about one-eighth inch by February 21, 1949. One crack about one-sixteenth inch in width and several very narrow cracks developed, presumably because of compression set that resulted from the increase in moisture content during the summer and because of the redrying during the winter. The behavior of quarter-sawed panel 5 was somewhat similar to that of flat-sawed panel 1, but changes in the former were slightly less.

Panels 2 and 6 were in satisfactory condition so far as freedom from objectionable cracks and buckling was concerned. These panels swelled 0.11 and 0.12 inch, respectively, or about 0.2%, up to September 17, 1948, and then by February 21, 1949, had shrunk to within about 0.01 inch of the strip-width totals as of November 28, 1947.

Panels 3, 4, 7, and 8 underwent negligible changes in strip-width totals, but all developed objectionable cracks. As a result of moisture absorption the cracks were much smaller during the summer than during the following winter, when redrying occurred.

On September 17, 1948, panels 4 and 8, which had an initial moisture content of 12%, had much higher percentages of small cracks, as well as wider cracks, than panels 3 and 7, which had an initial moisture content of 9%. In panels 4 and 8, the percentages of larger cracks decreased during the summer as a result of the absorption of moisture and increased during the following winter when the flooring redried.

Fig. 4 and 5 show the appearance of panels 1, 2, 3, and 4 on February 23, 1949. As previously stated, panel 1 had buckled, panel 2 was satisfactory, and panels 3 and 4 had objectionable cracks.

Recommendations

Observations thus far have indicated that the following steps will be helpful in minimizing objectionable shrinking and swelling of strip flooring laid over radiant-heating pipes embedded in concrete in dwellings:

(1) Provide a moisture-resistant membrane below the concrete floor slab.
(2) Provide adequate drainage away from the dwelling.
(3) Prevent rain from entering through walls and around windows and doors.
(4) Use lumber uniformly dried to a moisture content adapted to the climate in which it will be used. In a climate similar to that of Madison, Wis., this moisture content should be about 6%, but for a milder climate, such as that of Atlanta, Ga., it is possible that a moisture content of 8 or 9% would be preferable. With reference to Fig. 1, moisture content of floors laid over radiant-heating coils should be about 2% less than average values shown.
(5) Have the flooring delivered to the dwelling after the concrete and plaster are thoroughly dry.
(6) Avoid the use of warped flooring strips.

Storage of Lumber

With flooring and interior trim, it is advisable to provide heated storage during damp weather in order to maintain the lumber at the desired moisture content.

To determine what temperature should be maintained within the storage shed in a given case, consult Fig. 6. For example, if the outdoor temperature is 30F, the relative humidity 80%, and the desired equilibrium moisture content is 8%, proceed as follows: From the intersection of the (vertical) 30F temperature line and the (horizontal) 80% R.H. line, extend a line midway between the adjacent (concave) vapor-pressure lines until it intersects a line midway between the 7 and 9% moisture content lines indicated on the right-hand ordinate. The reading on the bottom scale at the point of the second intersection is about 47F. In other words, under the conditions stated, the moisture content of the flooring can be maintained merely by heating the air to 47F.

Tested Practice in Steam and Hot Water Heating for Houses

A Resume of Research at the University of Illinois

Prepared by

WARREN S. HARRIS
Special Research Associate Professor

and

ROBERT H. WEIGEL
Special Research Assistant

Part 1

- **Test Equipment**
- **Radiant Baseboards**
- **Heat Emission and Distribution**
- **Heat and Moisture Transmission**

Tested Practice in

Steam and Hot Water Heating for Houses

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Since the turn of the century, the University of Illinois has conducted research in steam and hot water heat for houses under various cooperative programs. The resulting extensive library of bulletins and reports has been condensed into this two-part publication retaining the gist of information pertinent to current practice and referring to original publications by number for details. Part 1, which follows, covers heat emission and distribution from radiators, convectors, and radiant baseboards; and discusses heat and moisture transmission in houses. Part 2 will be published next month.

Part 1

FROM the time the Engineering Experiment Station was first established at the University of Illinois, emphasis has been placed on the combustion of fuels and the performance of heating systems. The seventh bulletin to be published by the Station was titled "Fuel Tests with Illinois Coals" and was printed in 1906. The first publication of the Station reporting tests on steam or hot water heating equipment is dated 1909 and is titled, "Fuel Tests with House-Heating Boilers." The complete list of Station publications shows that experimental work on the combustion of fuels and the performance of heating systems has been continuous from the time of the first publication in 1906 down to the present time and, in all, 48 bulletins and circulars in this area of work have been published.

The first cooperative research work in steam and water heating was started in the department of Mechanical Engineering in 1926 under the terms of a cooperative agreement with the Illinois Master Steam Fitter's Association and a group of cast iron boiler and radiator manufacturers. This agreement was discontinued in 1931 but the work was continued for several years under a cooperative agreement with the American Society of Heating and Ventilating Engineers.

In 1940 the Institute of Boiler and Radiator Manufacturers entered into a cooperative agreement with the Engineering Experiment Station for studies in steam and hot-water heating. Under the terms of this agreement the I=B=R Research Home was built near the University of Illinois campus. The cooperative research agreement between the Institute of Boiler and Radiator Manufacturers and the Engineering Experiment Station of the University of Illinois has been continuously in effect since it was first signed in 1940 and an extensive research program on steam and water heating has been carried on in both the I=B=R Research Home and in the Mechanical Engineering Laboratory of the University.

As a result of the research work started in the early nineteen hundreds, and continuing more or less constantly down to the present time, considerable information has been obtained on the operation and performance of steam and hot-water heating equipment and

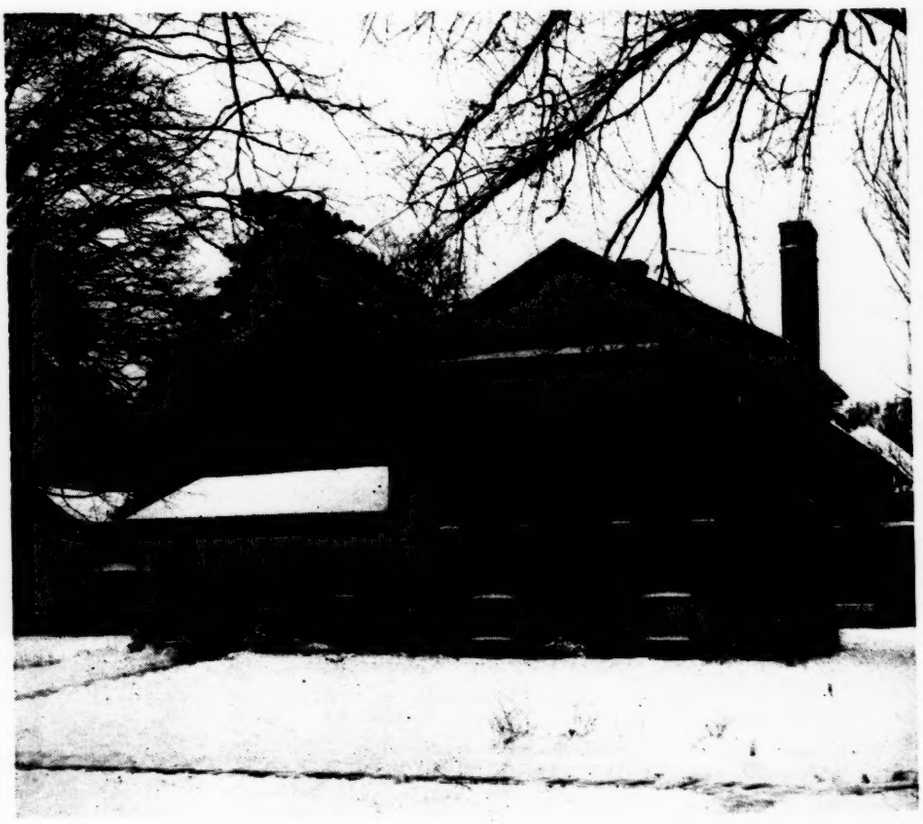


Fig. 1. I=B=R Research Home.

made available in various Engineering Experiment Station bulletins. This paper has been prepared so that a resume of the highlights of the entire research program on steam and water heating systems would be available in a single publication. For the most part no attempt has been made to present detailed discussions in this resume, but, rather, results and conclusions are given with a minimum of discussion and the reader is referred to the publications listed in the bibliography at the end of the report for detailed discussions of test equipment, test methods, and test observations.

I=B=R Research Home and Equipment

House: The I=B=R Research Home (6)[1] shown in Fig. 1, was built especially as a field laboratory. It is a typical, two-story, six-room, American home. The construction was brick veneer on frame, and all of the outside walls and the second-story ceiling were insulated with mineral wool bats 3⅝ inches thick. A vapor barrier offered resistance to the flow of the water vapor from the heated spaces into the insulation or to the outdoors. This vapor barrier consisted of a glossy-surfaced, asphalt-impregnated sheathing paper weighing 50 lb per roll of 500 sq ft applied with overlapping joints, and as continuous as possible, to the inside of the studs of all exterior walls, between the house and garage, and on the bottom of the second-story ceiling joists. The exterior walls were constructed as follows: One course of face brick, an air space, building paper, ship lap sheathing on 2- by 4-inch studs, insulation in the form of 3⅝-inch mineral wool bats, vapor barrier, rock lath and plaster with troweled finish. The calculated coefficient of heat transmission, U, for this wall section was 0.074 Btu per (sq ft) (hr) (F). All windows and outside doors were weatherstripped. Storm doors were used on the front entrance and the outside door in the dining room. The total calculated heat loss under design conditions with temperatures of —10F outdoors and 70F indoors, was 43,370 Btu per hr for the house, excluding the basement. Table 1 gives a summary of the calculated heat losses and volume of each room in the house.

Testing Apparatus: While the house was being constructed, approximately 100 copper-constantan thermocouples made of No. 22 B and S gage wire were permanently installed in the walls and ceilings in order to measure temperatures at important points in the structure under various operating conditions. At each of eight locations, one on each exposure of each story, nine thermocouples were installed to provide for establishing complete temperature gradients through the walls. Other thermocouples were installed in each recess to measure the temperature of the inside and outside surfaces of the sheathing directly back of the radiator. Another group of approximately 50 thermocouples provided for the measurement of air temperatures at various levels in the center of each room, in the attic, and in the basement. A fourth group made it possible to study the performance of the component parts of the heating system. Provision was made for measuring the temperature of the water entering and leaving each radiator, as well as the temperature of the water entering and leaving the boiler.

A central switchboard was located in the basement, and all of the thermocouples were connected to selector switches on this board. In this way the electromotive force of each thermocouple could be read quickly on a precision potentiometer used in connection with a highly sensitive galvanometer. A ten-point recording potentiometer used in connection with an auxiliary switchboard made it possible to obtain either instantaneous readings or continuous printed records of the electromotive force given by the thermocouples in any selected group.

Provision for measuring the rate of flow of water in the mains, and through each radiator in the heating system, was made by installing elbow meters to be used in connection with a sensitive differential pressure gage, or manometer. Use is made of the principle that a fluid flowing through an elbow creates a difference in pressure between one point on the inside radius and another point on the outside radius of the elbow. This difference in pressure is a measure of the rate of flow. This type of meter introduces no additional resistance to the flow of water.

Recording thermometers were used to make continuous records of the air temperatures in each of the six rooms, the outdoor air, and the flue gas temperatures. Continuous records of the CO_2 in the flue gases were obtained by means of a thermal-conductivity type recorder calibrated against an Orsat apparatus. The moisture content of the air was measured by means of four humidity indicators, one recording hygrometer, and one wet- and dry-bulb recorder which were checked periodically with an aspirated psychrometer. Drafts were measured by means of either inclined manometers or a recording draft gage, as the occasion demanded. The electrical input to circulator and burner motors was measured by means of integrating watt-hour meters reading directly to 10 watt-hours. Self-starting electric clocks were wired into the burner and circulator motor circuits in such a way as to indicate the total time of operation.

Heating System: The heating system in the Research Home was changed from year to year to suit the test conditions desired. Therefore, the heating systems used will be described in connection with the discussion of test results.

TABLE 1—DATA ON FIRST RESEARCH HOME

Room	Dimensions	Heated Space, Cu Ft	[1]Calculated Heat Loss, Btu per Hr (Without Storm Sash)
	First Floor		
Living Room	24 ft 0 in. × 13 ft 4 in.	2,641	5,749
Dining Room	13 ft 1 in. × 11 ft 3 in.	1,183	8,742
Kitchen	10 ft 5 in. × 11 ft 3 in.	799	3,199
Lavatory	7 ft 0 in. × 2 ft 8 in.	152	1,484
Vestibule	7 ft 5 in. × 5 ft 4 in.	284	4848
Vestibule Closet	.....	5,113	.....
Total (1st Floor)	.....	54	24,022
	Second Floor		
NE Bedroom	10 ft 7 in. × 9 ft 9 in.	800	4,393
NW Bedroom	10 ft 6 in. × 13 ft 4 in.	1,148	4,944
SW Bedroom	13 ft 0 in. × 11 ft 4 in.	1,108	5,250
Bath	6 ft 6 in. × 7 ft 6 in.	374	2,606
Stair Landing and Hall	.....	505	2,155
Closets	.....	345	.....
Total (2nd Floor)	.....	4,280	19,348
Total (1st and 2nd Floors)	.....	9,393	43,370
Basement	24 ft 0 in. × 25 ft 2 in.	5,084	32,810

[1]Based on 70F indoors and —10F outdoors.

Basementless House and Equipment

House: In addition to the Research Home, which had a full basement, a basementless house (14) was used in part of the test program. The basementless house, shown in Fig. 2, was of prefabricated construction. The

[1]Numbers in parentheses refer to the bibliography at the end of Part 2 of this article.

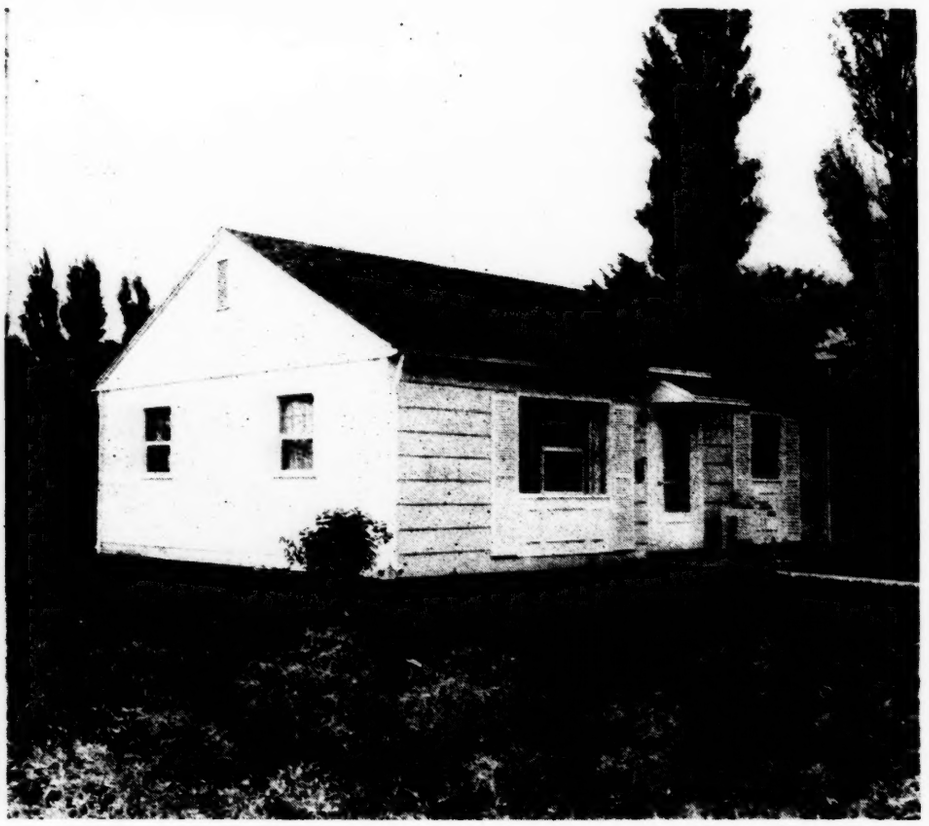


Fig. 2. Basementless House.

walls were composed of ⅜-inch fiber wall board on the room side, 2- by 3-inch wood framing members, and ⅜-inch plywood on the exterior. One inch of cotton insulation, provided with a vapor barrier, was applied to the wall board between the framing members. The calculated coefficient of heat transmission, *U*, for this wall section was 0.16 Btu per (sq ft) (hr) (F). The ceiling was composed of ¼-inch plywood, 2 inches of cotton insulation, and 2- by 4-inch joists, for which the *U* value was 0.13 Btu per (sq ft) (hr) (F). The house was erected on a 4-inch concrete floor over a 4-inch gravel fill, and to minimize the heat losses at the edge of the slab, 1-inch waterproof board insulation was installed around the periphery and between the slab and foundation. A vapor barrier was placed between the slab and gravel fill to prevent excessive vapor transmission. Calculated heat losses through the floor were based on a factor of 0.06 Btu per (sq ft) (hr) (F) and a design temperature difference of 80F was assumed.

All windows and doors were weatherstripped, and storm doors were used on both outside entrances. The total heat loss, based on —10F outdoor temperature and 70F indoors, was 42,312 Btu per hr. The total floor area of the heated space was 713 sq ft, and the volume was 5,702 cu ft. Table 2 gives a summary of the calculated heat loss and the volume of each room in the house.

Testing Apparatus: The instrumentation of the basementless house was not as elaborate as the instrumentation of the Research Home. However, adequate provision was made to evaluate the performance of the heating system being tested. The principal reason for using the basementless house was to determine the effect of the use of radiant baseboard on floor slab temperatures. Therefore, while the house was being erected, copper-constantan thermocouples were located in the living room and kitchen floor slabs. Slab temperatures in the living room were measured in a plane perpendicular to the west wall and baseboard radiation extended not less than 7 ft 6 inches on either side of the plane in which the thermocouples were located. Therefore, the temperatures measured in this plane were fairly representative of slab temperatures that existed in any plane perpendicular to a wall at a point where baseboard radiation was located.

With one exception, the thermocouples in the kitchen floor slab were located in a plane perpendicular to the north wall and at a distance of 4 ft 10 inches from the baseboard radiation on the north wall of the living room and 4 ft 9 inches from the nearest radiation in the kitchen. Since the closest radiant baseboard was 4 ft 9 inches away from the plane of the thermocouple location, the temperatures measured by those thermocouples were probably representative of slab temperatures that would have been obtained had no baseboard radiation been used.

A group of eight thermocouples was provided for the measurement of air temperatures at various levels in any room of the house. Four of these thermocouples were attached to a portable standard at levels of 3 inches, 30 inches and 60 inches above floor, and 3 inches below the ceiling. The other four thermocouples were similarly attached to a second standard. The lead wires to the thermocouples were of sufficient length to permit locating the standards in any room. The use of portable standards gave maximum flexibility to measuring air temperatures and, when not in use, they could easily be stored in the utility room. A third group of thermocouples was provided to study performance of the component parts of the heating system, including the temperature of the water entering and leaving each circuit, and the temperature of the water entering and leaving the boiler. A chromel-alumel thermocouple, made of No. 22 B and S gage wire, was located at the smoke outlet of the boiler.

A central switchboard was located in the utility room and all of the thermocouple leads were connected to jacks on this board. Each hot junction was provided with an individual cold junction which was maintained at 32F by means of an ice bath. All cold junctions were insulated electrically by wrapping with thread and coating with ambroid. A portable precision potentiometer and a 10-point recording potentiometer provided means for either instantaneous readings of the emf of each thermocouple and/or continuous printed records of the emf given by any copper-constantan thermocouple. The range of the 10-point re-

TABLE 2—DATA ON BASEMENTLESS HOUSE

Room	Dimensions	Heated Space, Cu Ft	Calculated Heat Loss, Btu per Hr
Utility Room	8 ft 0 in. × 11 ft 10 in.	755	5,490
Kitchen	9 ft 3 in. × 11 ft 10 in.	784	6,384
Living Room	11 ft 10 in. × 19 ft 10 in.	1,869	13,680
Front Bedroom	9 ft 11 in. × 11 ft 10 in.	935	7,182
Rear Bedroom	8 ft 9 in. × 11 ft 10 in.	831	6,612
Bath	5 ft 0 in. × 8 ft 1 in.	324	2,394
Hall	7 ft 1 in. × 3 ft 7 in.	204	570
	TOTAL	5,702	42,312

[1]Based on 70F indoors and —10F outdoors.

cording potentiometer, however, was —1 MV to +5 MV which did not permit recording of the flue gas temperatures.

A recording hygrometer was used to make continuous records of the air temperature and relative humidity at the 30-inch level in the living room. This instrument was checked periodically with an aspiration type psychrometer. The CO_2 content of the flue gases was checked periodically with an Orsat apparatus. Self-starting electric clocks were connected in parallel with the gas valve and the circulator motor, and recorded the total time of the operation of each unit during the test period. A gas meter was used to measure the quantity of gas used.

Heating System: The heating system tested in the basementless house is described in connection with the discussion of test results.

Mechanical Engineering Laboratory

Low Temperature Testing Plant (2): Special equipment in the Mechanical Engineering Laboratory included a low temperature testing plant and two warm wall test booths. The main portion of the low temperature testing plant was located on the upper floor of the Mechanical Engineering Laboratory and consisted of the test room, its attic and basement, all located within the insulated cold room. The auxiliary equipment, including the refrigerating apparatus, with the exception of the coils, the thermocouple switchboard, and the steam control and weighing apparatus, was located on the lower floor of the laboratory. Fig. 3 is an elevation drawing and shows the general arrangement of the plant. When originally built the low temperature testing plant contained two 9-ft by 11-ft test rooms, each with two sides exposed to the cold temperature maintained in the refrigerated space (cold room). Later, the plant was enlarged and the two rooms were replaced by a single 15-ft by 18-ft test room so arranged that it could be operated with either two or three sides exposed. Attic, basement, and cold room temperatures could be maintained at any desired level, each independent of the other two. The temperature of the test room was maintained at normal room temperature by operation of the heating unit under test. The plant was equipped with a complete thermocouple system for the purpose of observing both air and surface temperatures. Actual output of the unit under test was determined from the weight of condensate collected during the test period.

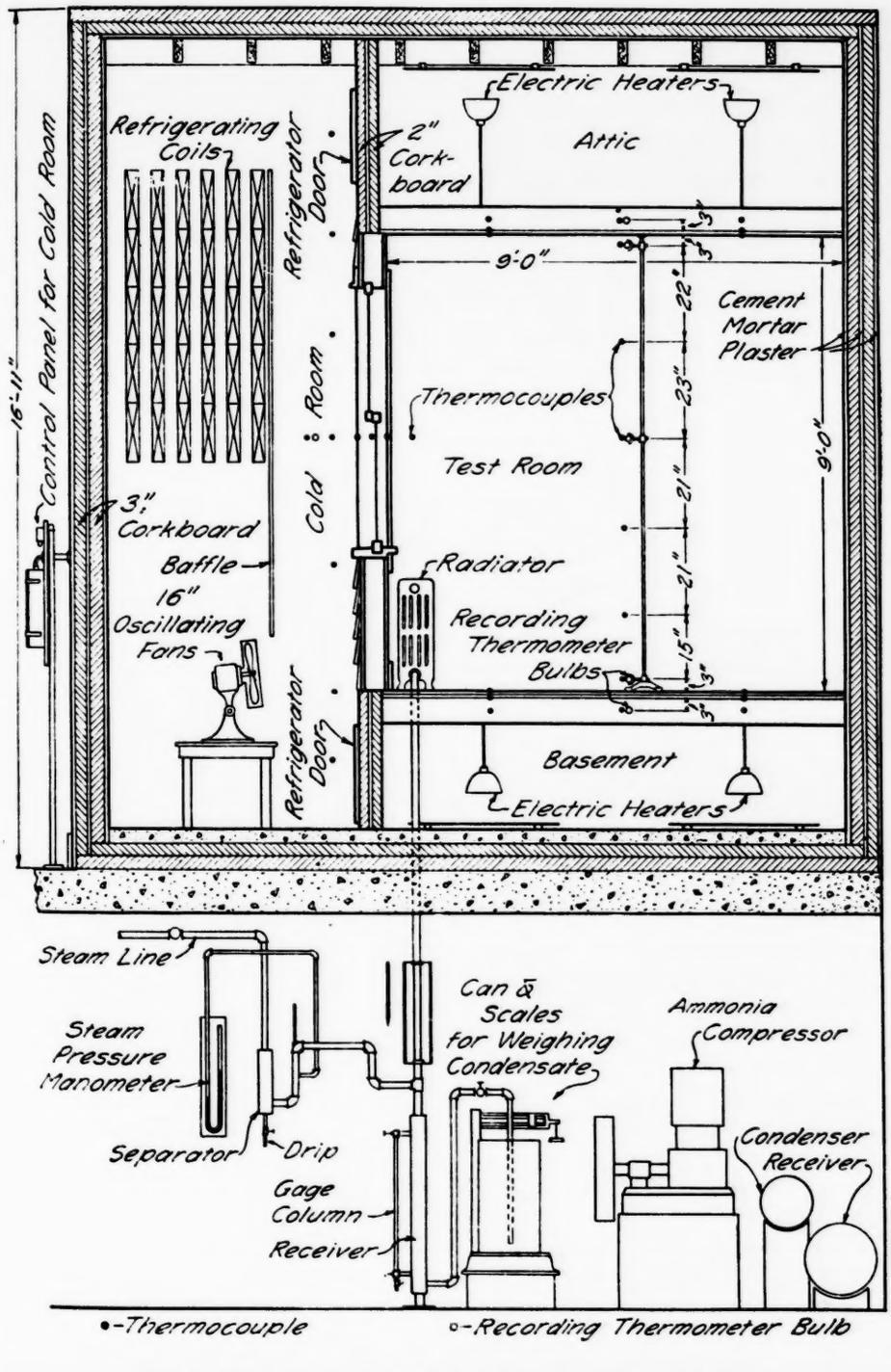


Fig. 3. Elevation section of low temperature testing plant.

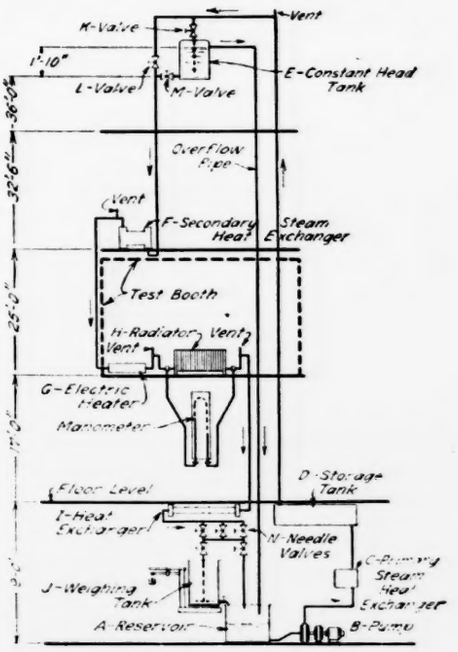


Fig. 4. Schematic arrangement of equipment in hot-water, warm wall test booth.

Warm Wall Test Booths (1, 7): The warm wall test booths were also used for radiator testing. These booths consisted of rooms enclosed on three sides but with the fourth side open to the laboratory. One of the booths was equipped with a steam supply and condensate weighing apparatus similar to that used in connection with the low temperature testing plant, making this booth adaptable to testing radiators and convectors on steam. The other booth was equipped with a water circulating system, water heaters, and provision for measuring the rate of circulation and the temperature drop of the water through the radiator being tested. This booth and its auxiliary equipment is shown schematically in Fig. 4. The radiator or con-

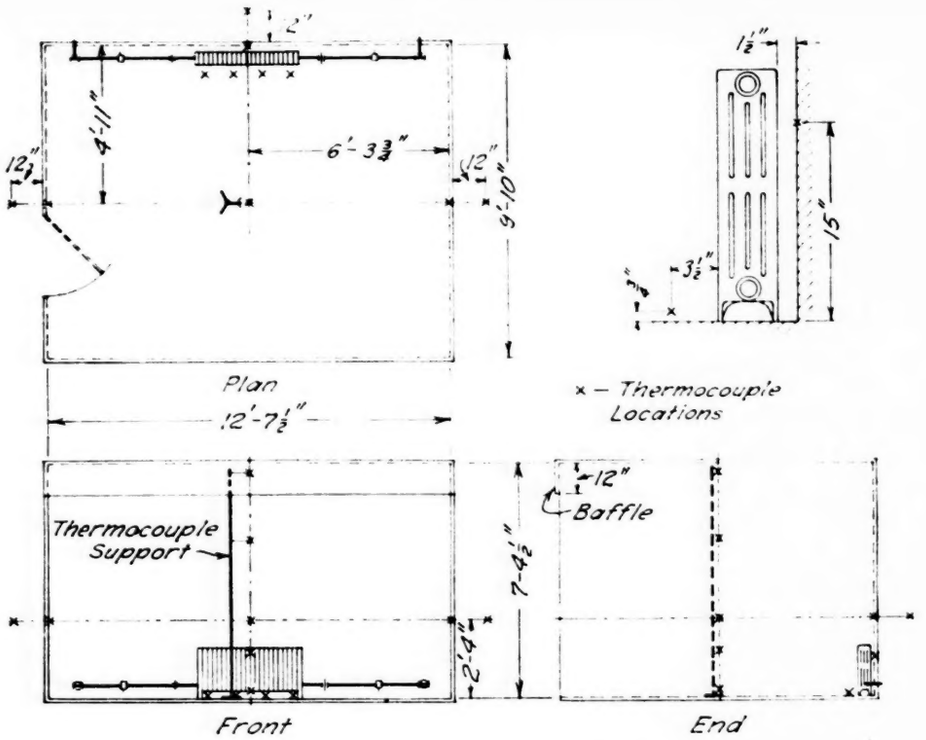


Fig. 5. Locations of radiator and thermocouples in test booth.

vector to be tested was placed in the booth as shown in Fig. 5. In order to prevent extraneous air circulation, the open side, located opposite the wall adjacent to which the radiators or convectors were installed, was provided with a baffle extending downward one foot from the ceiling. This booth was built of ½-inch wall board supported by a steel frame, and was not in contact with the floor, ceiling, or walls of the laboratory, so that it was completely surrounded by the laboratory air. By manipulation of the valves this system could be operated on gravity head furnished by water maintained at a constant level in the elevated constant-head tank, or water could be circulated directly through the radiator from the pump.

Emission and Distribution of Heat from Radiators and Convectors

Factors Influencing Heat Emission

Variation In Heat Emission and Flow of Water Through A Radiator by the Use of Different Connections for the Entering Water (7): Tests undertaken in the Mechanical Engineering Laboratory showed that the heat emission of a 19-inch, 4-tube, 22-section radiator was the same for water entering through the upper tapping as for water entering through the lower tapping. In both cases the water left the radiator through the lower tapping at the opposite end of the radiator.

When the water enters this radiator through the upper tapping the radiator may be considered as a two-pipe reversed-return, forced-circulation heating system. The upper row of push nipples, with the intervening spaces, may be regarded as the flow main; the lower row of push nipples, with the intervening spaces, as the return main; and each individual tube as an individual riser. Temperature readings also showed that circulation through the tubes increases as the distance from the inlet increases and that considerably less than one-half of the water flows through the two outer rows of tubes.

If the lower tapping is used the radiator functions primarily as a one-pipe heating system; a portion of the water, however, flows along the longer path of the upper push nipples and consequently the radiator functions also, to a slight degree, as a two-pipe reversed-return heating system. Closing off of the upper row of push nipples would eliminate this latter function. In any event, water entering the upper or lower tapping did not affect the heat transmission of the radiator.

Influence of Rate of Water Flow Through Heating Unit on Rate of Heat Emission (7): An increase in the water velocity will have different effects on the heat transmission of a tubular radiator than it will on the rate of heat transmission of a convector. When the flow was quadrupled through a cast iron radiator (from 454 lb per hr to 1,816 lb per hr) the rate of heat emission was reduced almost 6%. Similar increases in flow through a cast iron convector had no noticeable effect on the rate of heat transmission, whereas increasing the flow through a non-ferrous convector from 450 to 1,708 lb per hr increased the rate of heat transmission approximately 8%.

The reason for the reduction in rate of heat transmission from the cast iron radiator with increase in water velocity through the unit was that, with a higher velocity, a larger proportion of the total flow passed through the inner tubes. Consequently, the temperature of the outer tubes was not increased in proportion to the increase in the mean temperature of the water in the radiator; that is, in proportion to the average of the temperatures of the entering and leaving water.

The increase in heat emission with an increase in the velocity of the water through the non-ferrous convector undoubtedly resulted from the increased scrubbing effect of the water at higher velocities on the surface films of the three small pipes in the convector.

Comparison of Rates of Heat Emission of Radiators and Convectors Operating with Steam and Water at 215F (7): Additional tests were run on the radiators and convectors mentioned in the preceding section so that a comparison could be made between the rate of heat emission with steam as the heating medium with the rates obtained with hot water. In the case of the non-ferrous convector it was observed that when operating with steam the rate of heat emission was practically the same as that obtained with a high rate of water flow through the convectors (1,700 lb per hr).

With a cast iron convector as a steam heating unit the rate of heat emission was 2.8% higher than for the same convector functioning as a hot-water convector.

The increase in the quantity of heat emitted by the cast iron radiator functioning as a steam radiator over that obtained with it functioning as a hot water radiator was almost 5%.

The difference of 5% between steam radiation and hot-water radiation found in the heat emission of the 19-inch, 4-tube, 22-section radiator, with water flowing through it at the rate of 454 lb per hr, does not strictly apply to all small-tube, cast iron radiators. The heat emitted by a radiator varies with the temperature of the exterior surface. In the design of steam radiation, it is assumed that the steam temperature represents the mean temperature of the heating medium, and that the surface temperature is practically equal to the steam temperature. In this case these assumptions are reasonably accurate. In the design of hot-water radiation, it is assumed that the temperature of the exterior surface is practically the same as the average temperature of the water within the radiator, and that the latter is equal to the mean of the temperatures of the water en-

tering and leaving the radiator. Observations of the surface temperatures at various locations on the radiator showed that these assumptions may be quite inaccurate.

The difference between the exterior surface temperature and the mean of the temperatures of the water entering and leaving the radiator varies with the velocity of the water and with the width of the radiator. If the water enters the radiator through the lower tapping and with a high velocity, a considerable portion will pass out of the radiator without having circulated through the tubes, and the average temperature of the water within the radiator will be lower than the mean of the temperatures of the water entering and leaving. The difference between the average temperature of the water in the radiator and the mean of the temperatures of the water entering and leaving is greater for wide radiators than for narrow radiators. If the water enters the radiator through the upper tapping and with a low velocity, as in the case of gravity-circulation system, practically all of the water which flows through the radiator will circulate through the tubes, and the average temperature of the water within the radiator will be very nearly equal to the mean of the temperatures of the water entering and leaving; this is especially true in the case of very narrow radiators.

TABLE 3—RATIOS OF HEAT EMISSION RATES FOR RECESSED RADIATORS

Temperature Difference $t_w - t_a$ F	Free-standing Radiator	Radiator in Recess
	Ratios of Heat Emission Rates, Percent	
70	100	71
85	100	76
100	100	80
115	100	85
130	100	87

On the whole it seems safe to conclude: (1) that the rate of heat emission of a 19-inch, 4-tube, 22-section radiator is about 5% higher with the radiator functioning as a steam radiator than it is with it functioning as a hot-water radiator with a rate of flow of 454 lb of water per hr; (2) that the difference is greater than 5% for rates of flow larger than 454 lb per hr and smaller than 5% for rates smaller than 454 lb per hr; (3) that, other conditions being the same, the difference between the rates of heat emission of a radiator functioning as a steam radiator or as a hot-water radiator is very small.

Ratio of Rate of Heat Emission of a Radiator Located in a Wall Recess to that of a Free-Standing Radiator (7): As compared to free-standing, recessing a 19-inch, 4-tube, 22-section radiator reduced its output by 13 to 29%, as shown in Table 3.

It is quite obvious that recessing the radiation reduced the heat emission materially and that the degree of reduction was a function of the temperature difference between the average temperature of the water in the radiator and the ambient air temperature. The higher this temperature difference the less reduction in heat emission because of recessing.

Paint on Radiators (15, 16): From data in Table 4 it is evident that the use of oil paints gave practically the same results irrespective of color. In the case of solar radiation, color is an important factor, but in the case of the infrared radiation given off by the low-temperature radiators color is a secondary factor, and the amount of heat radiated is determined by the contour and the nature of the surface. In the case of the tubular radiator the oil paints gave practically the same heat transmission as the unpainted surfaces.

The metal bronze paints reduced the efficiency of heat transmission, the reduction ranging from 7.4 to 9.2%. Thus the use of bronze paints is not to be recommended unless a corresponding increase is made in the size of the radiator. The use of bronze paints on radiators will not ordinarily affect the fuel consumption required to heat a given space.

Factors Influencing Heat Distribution

Radiator Enclosures and Shields (1, 2, 3): Tests have shown that the use of a properly designed enclosure or shield on a tubular or column radiator results in a gain in steam economy, and equally or more satisfactory air temperature conditions in the room as compared with those obtained by the use of the same radiator unenclosed. Apparently, however, there is little or nothing to be gained by the use of enclosures or shields on wall radiators.

TABLE 4—EFFECT OF PAINT ON OUTPUT OF TUBULAR RADIATORS

Radiator Finish	Relative Rating, Percent	Source
Linseed oil, zinc, lithopone paint—brown color	104.9	(16)
Linseed oil, zinc, lithopone paint—cream color	104.0	(16)
Grey paint dipped	101.1	(15)
One coat dull black Pecora paint	100.0	(15)
White-gloss enamel	102.2	(16)
Bare iron, foundry finish	100.0	(16, 15)
Aluminum bronze	93.7	(16)
One coat aluminum bronze	90.8	(15)
Gold bronze	92.6	(16)

A properly designed enclosure or shield should offer a minimum of resistance to the flow of air over the radiator under gravity head, and should protect the wall behind the radiator against the effect of direct radiation from the radiator. It should have the top of the opening in the face of the enclosure as high as possible and permit free access of air over the lower half of the radiator, especially near the floor.

Fig. 6 shows the room temperature gradient obtained during tests made in the low-temperature testing plant located in the Mechanical Engineering Laboratory at the University of Illi-

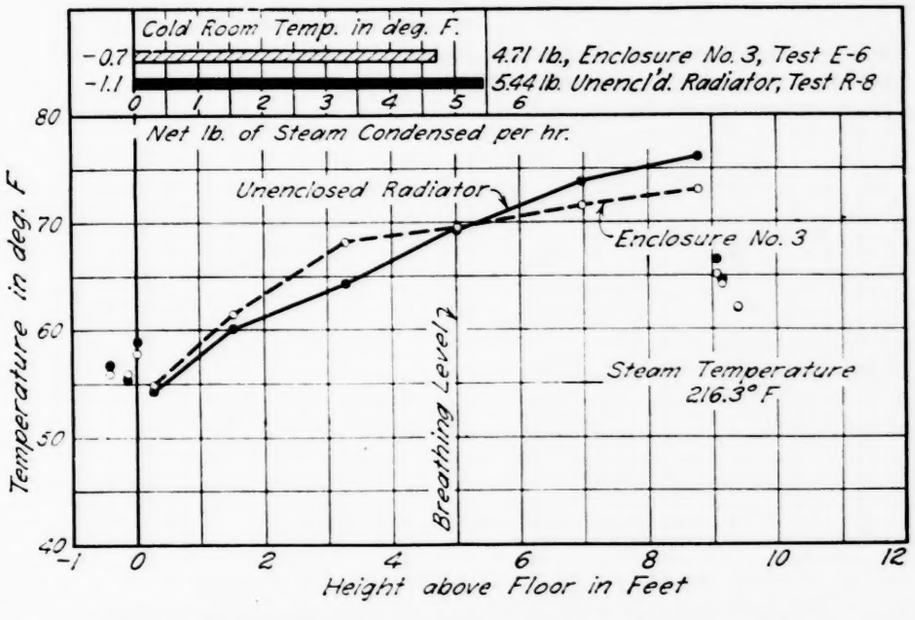


Fig. 6. Room temperature gradients in tests on a tubular radiator, enclosed and unenclosed.

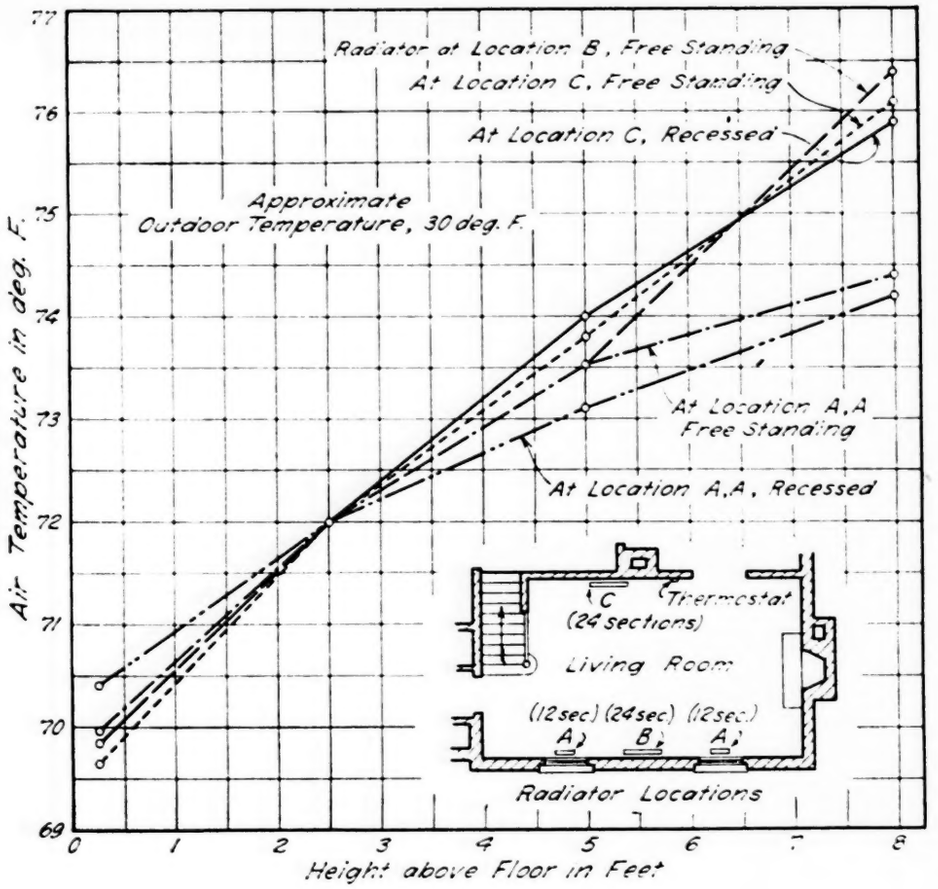


Fig. 7. Air temperature gradient in living room with five different radiator installations.

nois on an unenclosed tubular radiator, and on the same radiator when equipped with a properly designed enclosure. Perhaps one of the best indices of the comfort produced in a room by the heating system is the vertical air temperature gradient. Hence, this gradient is often used in comparing the performance of different types of heating systems. The use of the enclosure resulted in a higher temperature, and hence more comfortable conditions in the living zone, and in lower temperatures at the ceiling than those obtained with the unenclosed radiator. Furthermore, these results were obtained with less steam condensation in the case of the enclosed radiator. Thus the enclosure proved to be efficient in operation and effective as to the distribution of heat.

Radiator Location (6): The location of the radiator in the room is very important, as it affects both the air temperature distribution and the air movement and can easily mean the difference between a satisfactory and an unsatisfactory job. Taking all factors into consideration, the best location for a radiator is along an outside wall, under a window; the second best location is along an outside wall but not under a window; and the poorest location is along an inside wall.

At one time a study was made in the I=B=R Research Home in order to determine the effect of the location and arrangement of radiators on the comfort conditions maintained within a heated room. Tests were made in which five different locations and arrangements of radiators were used in the living room. In three of the installations, single radiators consisting of 24 sections of 19-inch, 4-tube, small-tube type radiation were used. In the other two installations the same amount and type of radiation was divided into two 12-section radiators. When the radiator was changed to the inside wall in the living room, corresponding changes were made in the location of those in the dining room and kitchen in order to minimize differences between rooms. In addition to the routine temperature readings made with each radiator installation, smoke studies were made in the living room in order to determine the nature of the air movement.

Fig. 7 shows the location and arrangement of the radiators used in each of the five installations tested and the air temperature gradient obtained in the living room with each installation. The temperature gradients shown in Fig. 7 were obtained for days when the average outdoor temperature was approximately 30F. These curves are also characteristic of those obtained for colder weather, but in the latter case the gradients were steeper and the differences in the temperatures produced by the various installations were accentuated. At an outdoor temperature of 15F the temperatures at the floor were approximately 1 degree lower and the temperatures at the ceiling were from 1 to 1.5 degrees higher than those shown in Fig. 7. The curves in Fig. 7 indicate that with a given radiator location, similar temperature gradients were obtained within the room with both the free-standing and the recessed arrangements. All five of the radiator installations produced approximately the same temperature gradient in the living zone, or that portion of the room below the 60-inch level. However, at the floor and at the 60-inch level slightly higher and lower temperatures, respectively, were obtained with the recessed radiators under the windows than were obtained with the other installations.

The lowest ceiling temperature, approximately 74.5F, resulted when the radiators were placed under the windows in position *A*. Slightly more than 76F was obtained when they were located adjacent to the walls in positions *B* or *C*. Normally, high temperatures at the ceiling have little bearing upon the comfort of occupants, but they do result in higher heat losses from the structure, particularly in rooms having ceilings exposed to the outdoors or to unheated attic spaces.

From the consideration of temperature gradients it would appear that just as good operating results may be obtained from a radiator located along an inside wall as may be obtained from one located in any other position except under a window. However, since both dry-bulb temperature and air movement are factors influencing comfort conditions, the use of air temperature gradients alone as a basis for comparing the performance of different radiator installations in a given room may be misleading. Smoke studies, therefore, were made in the living room to determine the amount and direction of the air movement resulting from the use of each of the five radiator installations. Results are shown by the diagrams in Fig. 8. These diagrams show the locations in which high or critical air velocities occurred, and the numbers indicate the magnitudes of the velocities in feet per minute.

When the two radiators were located in the positions shown as *A*, Fig. 7, up currents of heated air from the radiators intercepted any down currents of cold air from the windows and thus prevented cold drafts across the floor. At the same time the cold air coming down over the windows mixed with the heated air rising from the radiators and thus lowered the temperature of the air traveling towards the ceiling. As a result the temperature of the air at the ceiling was moderated. Since even in very cold weather the temperature of the inside surface of exposed walls was only about 3 degrees lower than that of the air in the room, there was little flow of cold air down these walls and across the floor.

When the two small radiators, located under the windows at *A*, were

replaced by a single radiator located between the windows at *B*, the air currents across the floor of the room remained practically the same except for a slight movement of cool air from the windows toward the center of the room. A greater part of the cool air from the windows, however, was drawn directly into the radiator. In the absence of a window or other cold surface above the radiator the heated air rose to the ceiling, resulting in comparatively high temperatures, as shown in Fig. 7. It then settled uniformly throughout the room.

With radiators along the exposed wall (*A* or *B*, in Fig. 7), cool air from the vestibule and stairway entered the

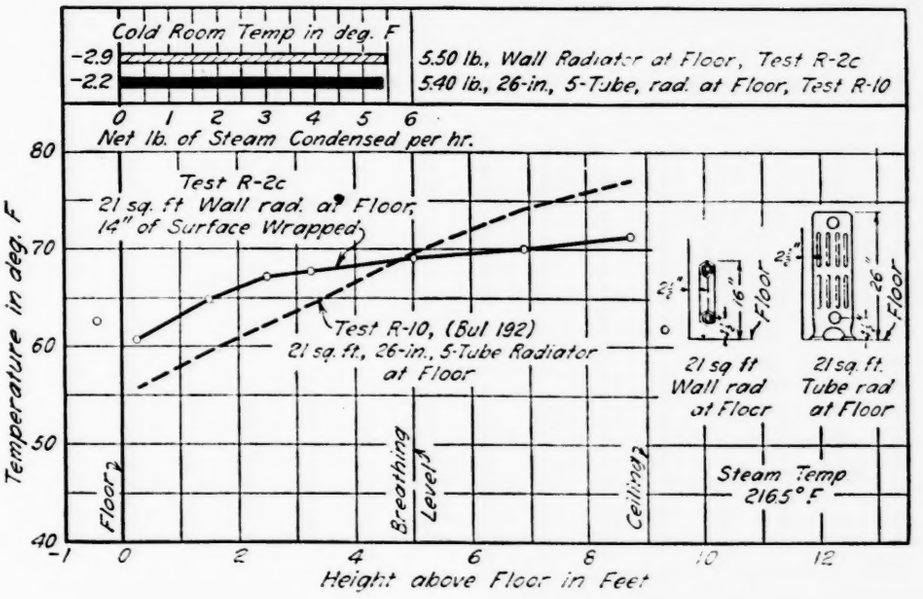
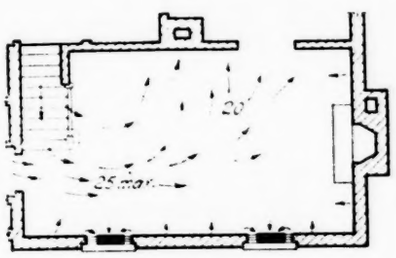
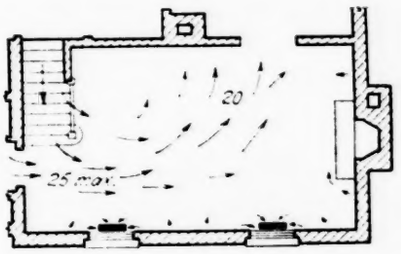

Cold Room Temp in deg. F
-2.9
-2.2
5.50 lb., Wall Radiator at Floor, Test R-2c
5.40 lb., 26-in., 5-Tube, rad. at Floor, Test R-10
0 1 2 3 4 5 6
Net lb. of Steam Condensed per hr.
Test R-2c
21 sq. ft Wall rad. at Floor, 14" of Surface Wrapped
Test R-10, (Bul 192)
21 sq. ft., 26-in., 5-Tube Radiator at Floor
21 sq ft Wall rad at Floor
21 sq. ft. Tube rad at Floor
Steam Temp 216.5°F
Temperature in deg. F
Floor
Breathing Level
Ceiling
Height above Floor in Feet

Fig. 9. (Above) Operating characteristics of tubular and of wall-type radiators.

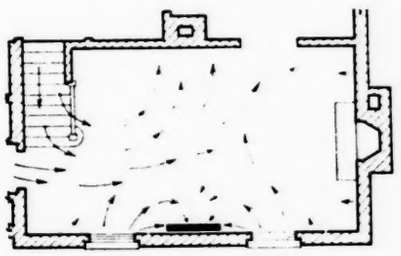
Fig. 8. (Below) Air movement in living room with five different radiator installations.



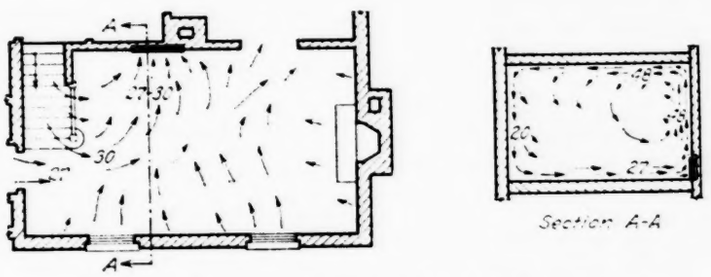
(a)-Two Radiators Recessed Under Windows



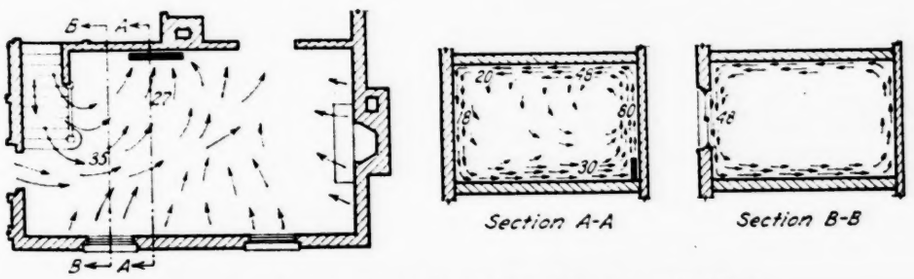
(b)-Two Radiators Free Standing Under Windows



(c)-One Radiator Free Standing Between Windows



(d)-One Radiator Recessed in Inside Wall



(e)-One Radiator Free Standing Along Inside Wall

room and the main current moved in a large arc through the middle of the room toward the unexposed wall and archway between the living room and dining room. The maximum velocity was approximately 25 ft per min. No objectionable drafts were observed at any time during the operation of the heating system with the radiators at either position.

A marked increase in the movement of air over the floor was observed as soon as the radiator was placed along the inside wall at position *C*. In this case the main air current originating in the vestibule and at the stairway was augmented by cold air from the windows and exposed walls. Air velocities across the floor as high as 35 fpm were observed. Under these conditions, cold drafts were noticeable around the ankles, and the room was less comfortable than it was when the radiators were located along the exposed wall, in spite of the fact that the temperature of the air at the floor remained unchanged at 69F.

Increasing the velocity of air at 69F from 20 fpm to 35 fpm lowers the effective temperature by approximately one-half degree. With a given air movement this is equivalent to lowering the dry-bulb temperature 1.5 degrees, or from 69F to 67.5F. Such a change is of sufficient magnitude to be distinctly noticeable, particularly when occurring near the lower limit of comfort.

Radiator Design (3): Tests made in the low temperature testing plant indicate that long, low, thin radiators placed under windows heat a room more comfortably and more economically than short and tall radiators similarly placed. The low radiators maintain materially better floor-to-ceiling temperature differentials than do tall, short radiators.

The results of the tests are shown

graphically in Fig. 9. From Fig. 9 it is evident that when the tubular and the wall-type radiators were operated under practically identical conditions with 69.6F and 69.3F, respectively, at the breathing level in the test room, and corresponding temperatures of minus 2.2F and minus 2.9F in the cold room, the temperature conditions in the room were much improved by the use of the wall radiator. When using the wall radiator the temperature difference between the air at the floor and at the ceiling was only 10.8 degrees, as compared with 21.4 degrees obtained with the tubular radiator. Moreover, the temperature of the air 3 inches above the floor was 60.8F with the wall radiator and only 55.7F with the tubular. The average temperature of the whole "living zone," or zone below the breathing level, was considerably cooler when using the tubular radiator than when the wall radiator was used even though the temperature at the breathing level was the same in both cases. A fair criterion for this condition may be obtained by comparing the temperatures at the 30-inch level, since the temperature at this level is a reasonably close approximation of the average temperature in the whole zone below the breathing level. These temperatures were 67.3F and 62.2F, respectively, for the wall and the tubular radiators.

In addition to the tests in the low-temperature testing plant some corollary data were obtained from radiators installed in two second-story office rooms in the south wing of the Mechanical Engineering Laboratory. These two rooms had substantially the same amount of exposed wall and glass area, and both were exposed to the same outdoor conditions. One room, No. 212, was heated by a wall radiator located under the windows; the other, No. 214, was heated by a 38-inch, 2-column radiator. The results of the tests in the office rooms were in general agreement with the results obtained in the low-temperature testing plant, except that, for the wall-type radiator in the office, the floor-to-ceiling temperature difference was only 2 degrees instead of 10 degrees as obtained in the low-temperature testing plant. Subsequent to the above tests a wall radiator was installed in room No. 214 in place of the 38-inch 2-column radiator. After this change the temperature gradient in room 214 agreed with that in room 212, proving that the radiator design, and not the slight differences in the size and exposure of the two office rooms, was responsible for the difference in the temperature gradients obtained.

Radiant Baseboard

To take advantage of the better operating characteristics of long, low radiators and to improve the appearance in the room, a unit has been developed which extends along practically all of the outside wall and does not interfere with furniture placement. This is the radiant baseboard (8, 14) which seems to be destined to be very popular, both because of its excellent performance characteristics and because of its pleasing appearance in the room.

A discussion of radiant baseboard logically belongs in the preceding section where a discussion of the effect of radiator design on performance is given. However, because of the newness of this type of radiation a more complete discussion of its performance is warranted.

Two types of radiant baseboard, the type R and the type RC, have been tested in the I=B=R Research Home. These units were made in the form of a hollow, cast iron baseboard and were installed along the outside walls of the room, replacing the conventional wooden baseboard. The type R unit has a continuous front extending from the floor to the top of the unit so that room air can circulate over one side only. The type RC unit is similar to the type R radiant baseboard except that air openings are provided along the top and bottom of each section to permit room air to circulate over the finned wall side of the heating unit as well as over the front. As a result the output of a type RC radiant baseboard is materially greater than the same height type R unit.

TABLE 5—RADIATION USED IN I=B=R RESEARCH HOME FOR VARIOUS TEST SERIES

Room	Installed Radiation				
	Series S	Series C-44		Series A-46	
	No. of Sections of 19-in., 4-tube, Small-Tube Radiation	No. of Sections of 19-in., 4-tube, Small-Tube Radiation	Linear Ft of 7-in. Type R Radiation Baseboard	No. of Sections of 19-in., 4-tube, Small-Tube Radiation	Linear Ft of 7-in. Type RC Radiant Baseboard
First Story					
Living Room	17		18		11
Dining Room	14		20		11
Kitchen	11	11			5
Lavatory	9		6		3
Vestibule	16	16		13	
Second Story					
NE Bedroom	10		14		9
NW Bedroom	10		16		10
SW Bedroom	8		16		10
Bath	11	11		7	
Stair Landing	7	7		6	

Objects of Investigation

Tests in the Research Home were undertaken to determine the operating characteristics of type R and of type RC radiant baseboard when used in conjunction with a two-pipe, reversed-return, gravity, hot-water system operated under actual use conditions, and to compare these operating characteristics with those of small-tube radiators under similar conditions of operation.

Since the Research Home was erected with a basement, whereas in the past several years a large percentage of American homes have been erected without basements, supplemental tests were undertaken in one of the University's faculty homes to determine the operating characteristics of a hot-water heating system using cast iron radiant baseboards in a basementless type of structure having a floor consisting of a concrete slab on the ground. Of particular interest was the floor slab temperature this heating system would maintain.

Heating Systems

During the 1943-44 heating season, a one-pipe, forced-circulation, hot-water system employing small-tube type, 19-inch, 4-tube, cast iron radiators, set in open recesses below the windows in all rooms, was used in the Research Home. These tests were designated as series S.

During the next two heating seasons low-height radiant baseboard replaced the small-tube radiators in the living room, dining room, all three bedrooms, and the lavatory of the Research Home. A two-pipe, reversed-return, gravity, hot-water system supplied the radiators. The tests with type R radiant baseboard, 1944-45 heating season, were designated as series C-44, while

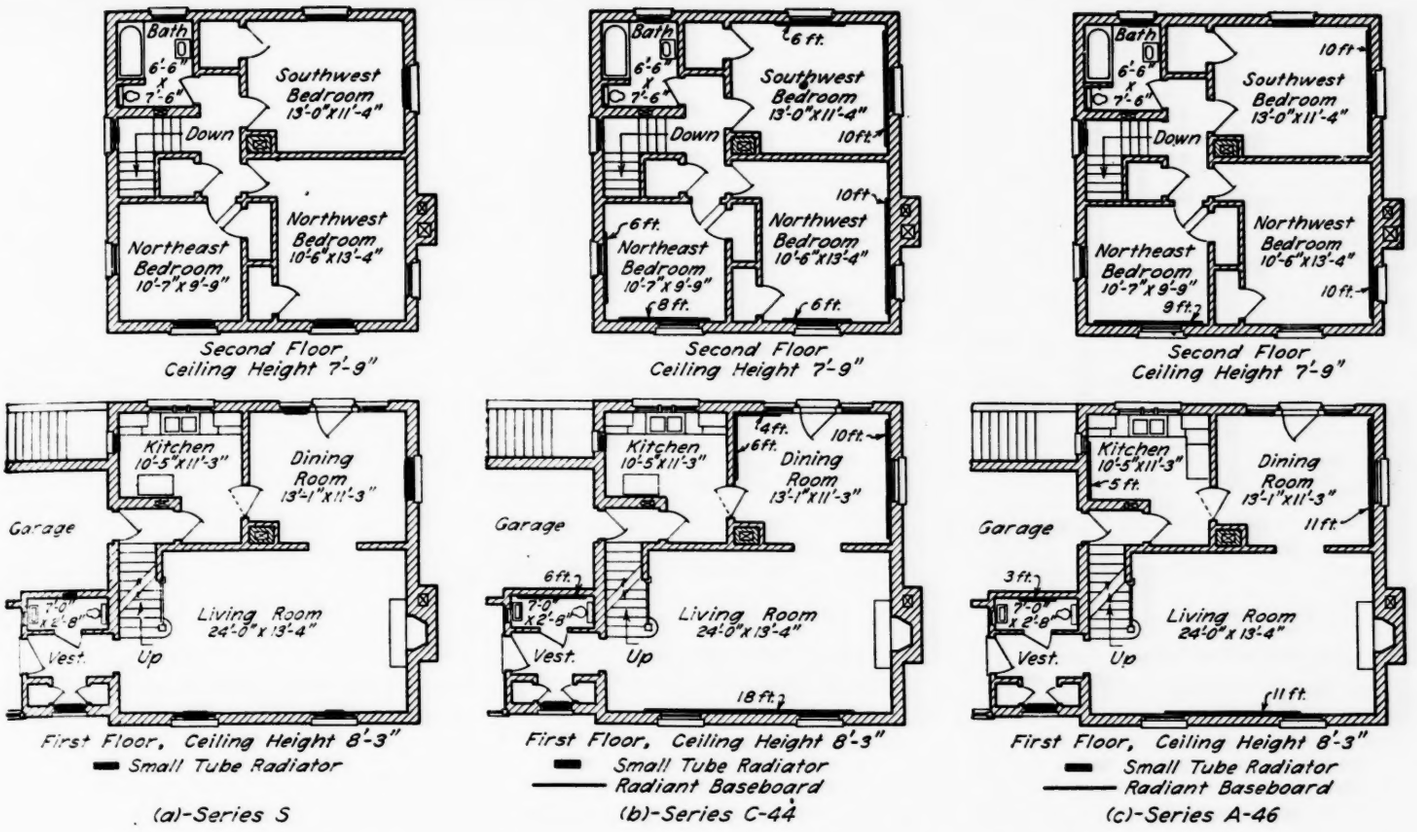


Fig. 10. Floor plans of I = B = R Research Home showing locations of radiation used for Series S, Series C-44, and Series A-46.

those conducted with type RC radiant baseboard. 1945-46 heating season, were known as series A-46.

The location of the radiation used in the Research Home for each series of tests is shown in Fig. 10 and the amount of radiation is given in Table 5. Rice paper, located between the wall and the radiator, and securely fastened under the molding along the top of the unit, served as a dust seal to prevent streaking the walls.

The system used for series S was designed to operate with a mean water temperature of 200F at an indoor-outdoor temperature difference of 80F, while the other two systems were designed to operate at a mean water temperature 15 degrees higher. For each series the amount of radiation installed in each room was just sufficient to offset the calculated heat losses of the room at design conditions with the following exceptions:

(1) No reduction was made in the amount of small-tube radiation used in series C-44 to compensate for the increased output per section due to changing water temperature from 200F to 215F.

(2) In series S, the radiation installed in the dining room and the SW bedroom was reduced from the amount indicated by the heat loss calculations to compensate for the heating effect of the sun in these rooms. No difference in the operating characteristics of the heating system were noted when these radiators were reduced in size.

Type RC radiant baseboard in the basementless house was used in conjunction with a one-pipe, forced-circulation, hot-water system operating as a series loop installation. The location, installation, and piping to these units are shown in Fig. 11, while the amount of radiation installed in each room is given in Table 6. The radiators in the living room and kitchen were connected in series and comprised one circuit, while the radiators in the two bedrooms and bath were connected in series to form a second circuit. This system was designed to operate at a mean water temperature of 215F at an indoor-outdoor temperature difference of 80 degrees and a 20-degree drop through each circuit.

TABLE 6—RADIATION USED IN THE BASEMENTLESS HOUSE

Room	Installed Radiation, Linear Ft of 7-in., Type RC Radiant Baseboard
Kitchen	10
Living Room	26
Front Bedroom	15
Rear Bedroom	14
Bath	5

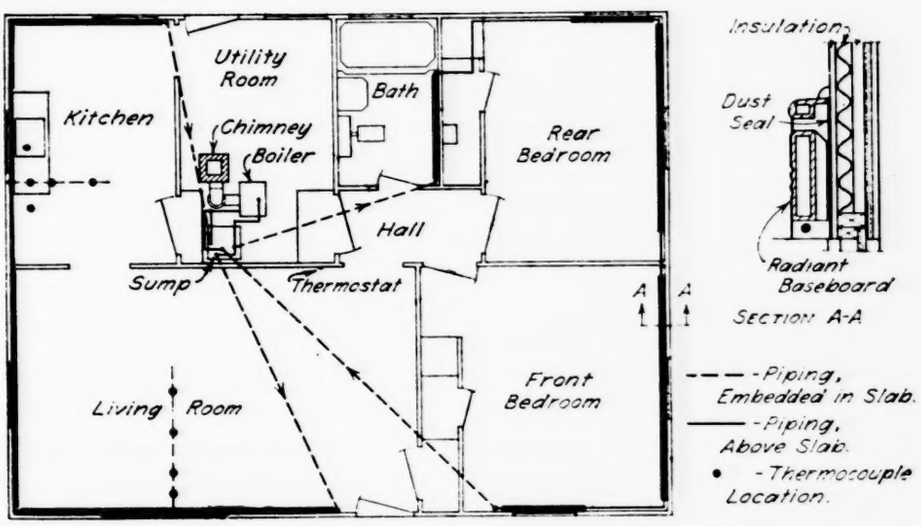


Fig. 11. Floor plans of basementless house showing location of baseboard radiation.

A conventional cast iron boiler was used in both houses; both were made by the same manufacturer and had a net I=B=R rating of 55,000 Btu per hr and a gross I=B=R output of 84,000 Btu per hr. Both boilers were supplied with a conversion-type gas burner, adjusted to a burning rate of approximately 100 cu ft per hr of natural gas having a high heating value of 1,000 Btu per cu ft. A CO_2 content of from 9 to 10% was obtained at the smoke outlet of the boilers.

Control System

The control system in the basementless house and for series S, series C-44, and for series A-46 in the Research Home were almost identical; the high limit control in the former was in the low-voltage circuit, while for the latter three systems the high-limit control was in the high-voltage circuit; also, series C-44 and series A-46 did not use a circulator. The control system consisted of a heat-anticipating room thermostat located 30 inches above the floor, a high limit control, a magnetic gas valve, a safety pilot, a transformer, and a relay. In all of these tests the thermostat was set to maintain 72F both day and night. The control system and sequence of operation for the forced circulation hot water systems

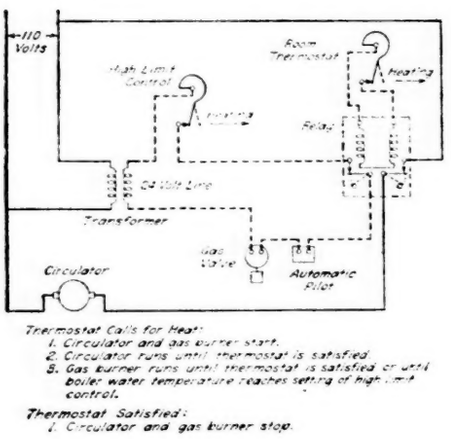


Fig. 12. Control system.

are shown in Fig. 12. Domestic hot water was not being provided by the boiler.

Test Results

Room Temperature Differentials: When changes were made in the radiation for each series of tests in the Research Home, all of the radiators in the second-story bedrooms were replaced, while some of those on the first-story were left unchanged. Hence it was considered that only the air temperature differentials observed in the second-story should be used in making a comparison of the operating characteristics of the several types of radiators used and, in this section, discussion of air temperatures in the Research Home has been confined to data

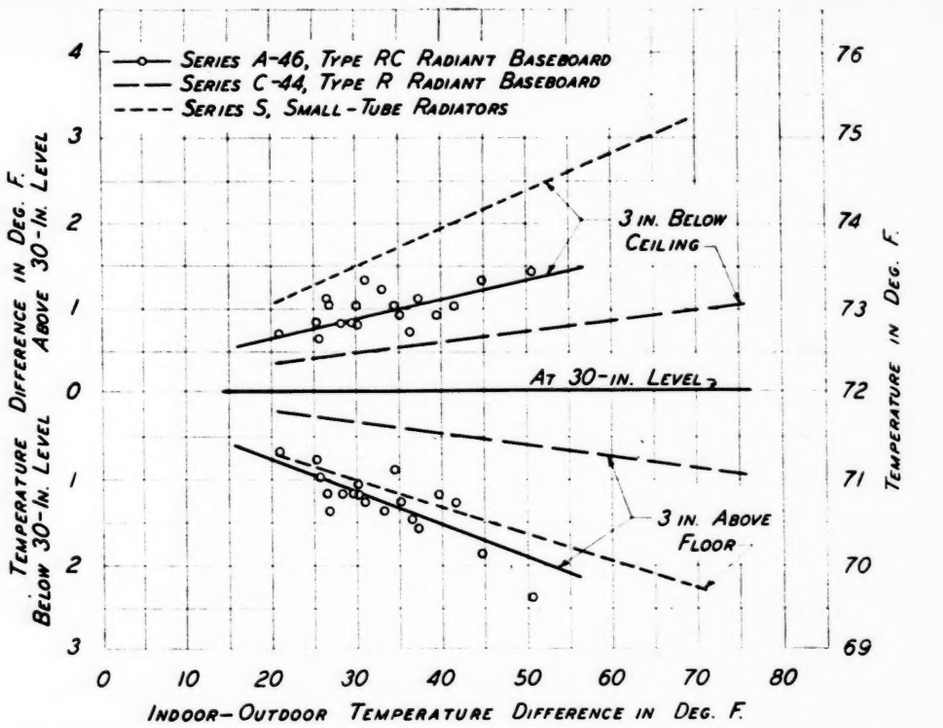


Fig. 13. Second-story air temperature in the I=B=R Research Home, Series S, Series C-44, and Series A-46.

obtained in the three bedrooms. Data obtained in the first-story rooms showed characteristics similar to those in the second-story rooms except that the floor to ceiling temperature difference was from 1 to 2 degrees greater.

Fig. 13 represents the observed air temperature differentials in the Research Home for each of the three types of radiation. For the sake of clarity, test points for the type RC radiant baseboard only are indicated. From this figure it is apparent that, for a given air temperature at the 30-inch level, both the small-tube radiators and the type RC radiant baseboard produced essentially the same air temperature 3 inches above the floor; while the air temperature 3 inches above the floor produced by the type R radiant baseboard was from 1 to 1.5 degrees warmer. The air temperature 3 inches below the ceiling was lowest when using the type R radiant baseboard, slightly warmer when using type RC radiant baseboard, and warmest when using small-tube radiators.

With all three types of radiation there was a gradual increase in the floor to ceiling air temperature difference with increasing indoor-outdoor temperature differences. At an indoor-outdoor temperature difference of 70 degrees, approximately equivalent to an average outdoor temperature of 2F and 72F at the 30-inch level, the floor to ceiling temperature differences produced by small-tube radiators, type RC radiant baseboard, and type R radiant baseboard were 5.6, 4.5, and 2.0 degrees, respectively. The floor temperatures, meanwhile, were 69.6, 69.2, and 71.1F, respectively.

From the foregoing discussion it would seem that:

(1) Type R radiant baseboard produces a warmer floor and cooler ceiling than either the type RC or the small-tube radiators.

(2) Type RC radiant baseboard produces a cooler ceiling than small-tube radiators.

Although the preceding conclusions are generally true, the air temperatures near the floor and ceiling depend not only on the type of radiation but also on the location of the radiators in the room, the heat output per linear foot of the radiator, and the heat loss per linear foot of exposed walls. Since the type RC radiant baseboard had a materially higher output per linear foot than did the type R units, the total length of the type RC baseboard used in each room of the Research Home was less than the length of the type R units. The type R units were installed along most of the exposed walls and under all of the windows in the bedrooms, whereas the type RC units were located on less than one-half of the exposed walls and under only one-half of the windows in the bedrooms. Thus, with the type R radiant baseboard practically all downward currents of cool air from the windows and walls were intercepted by currents of warm air from the heating units, while in the case of the type RC radiant baseboard the downward currents of cool air from one-half of the windows and from a major portion of the exposed walls were not intercepted by currents of warm air from the heating units and, therefore, spread out across the floor of the room, producing the relatively cool floor as compared to that obtained with the type R radiant baseboard.

Likewise, when the heat output per linear foot of the radiator is much greater than the heat loss per linear foot of the wall along which the radiator is located, the upward convection currents of warm air from the radiator are more than sufficient to offset the downward convection currents of cool air from the walls with the result that the surplus warm air rises to the ceiling. This demonstrates the desirability of selecting the type of radiation and the operating temperature which will make it necessary to place radiation along as much of the available exposed wall as is feasible.

For all practical purposes, the air temperatures obtained in the basementless house were the same as those obtained with type RC radiant baseboard in the Research Home. Average air temperatures in the center of the living room of the basementless house, as measured three inches above the floor, were approximately 70 to 71F for all indoor-outdoor temperature differences encountered. From the 30-inch level to the floor, temperature differences were only of the magnitude of 1.0 to 2.0 degrees. These temperatures were maintained even though there was a large and sometimes rapid change in the outdoor temperature, demonstrating that a hot water system using radiant baseboard can take care of sudden changes of load with little difficulty. These results, together with the results obtained in the I=B=R Research Home, indicate that the radiant baseboard, if properly installed, will maintain excellent air temperatures in homes built with basements or in those built on concrete slabs in direct contact with the ground.

Air Movement: In the section discussing air motion in rooms heated by conventional radiators, it was pointed out that with small-tube radiators located under the windows, the maximum air velocity across the floor was only approximately 25 fpm. Updrafts of warm air from the radiators intercepted any downdrafts of cold air from the windows and thus prevented cold drafts across the floor.

No smoke studies were made to indicate air motion across the floor of the room when using radiant baseboard, but no drafts could be detected by occupants of the house. Since the radiant baseboard was installed, not only under the windows, but also along a large share of the exposed wall, it is evident that in addition to neutralizing downdrafts of cold air from the windows, updrafts of warm air from the radiant baseboard also intercepted downdrafts of cool air all along the wall on which the radiant baseboard was installed. Therefore, no floor drafts would be expected as the possibility of cold drafts across the floor was even less when using radiant baseboard than when the small-tube radiators were used.

Wall Surface Temperatures: Fig. 14 shows wall surface temperatures, measured on the inside surface of the plaster on the north wall of the living room of the Research Home, resulting from the use of the conventional recessed radiators and the radiant baseboard. At the times that these observations were made, the outdoor temperature was approximately 32F and the temperature of the air in the living room at the 30-inch level was 72F. It may be observed that when using the radiant baseboard the temperature of the entire wall below the 60-inch level was greater than the temperature of the air in the room at the 30-inch level, whereas with the conventional recessed radiator the temperature of this portion of the wall surface was from 0.2 to 1.6 degrees below the temperature of the air at the 30-inch level. The wall temperatures obtained with the type RC radiant baseboard were essentially the same as those obtained with the type R units. At lower outdoor temperatures, the wall surface temperatures were even higher when using the radiant baseboard and somewhat lower when using the small-tube radiators than the corresponding values given in Fig. 14. Thus the radiant baseboard warmed the entire surface of the portion of the exposed wall along which they were installed. On the other hand, with the conventional recessed radiator, only the small portion of the wall forming the back of the recess was warmed, and this contributed nothing to comfort because this portion of the wall was hidden by the radiator, which was at a much higher temperature.

If all other factors except the wall surface temperature remained unchanged, the increase in the wall surface temperatures accompanied by the use of radiant baseboard would result in an increase in the mean radiant temperature in the room. However, measurements made at the 30-inch level by means of both a thermo-integrator and a globe thermometer at five different locations in the living room proved that with both conventional recessed radiators and radiant baseboard the mean radiant temperatures were essentially the same and were within one degree of the room air temperature at the 30-inch level. Thus the higher ceiling temperatures produced by the small-tube radiators must have produced about the same radiant effect as the warmer walls attained with the radiant baseboard. These mean radiant temperature observations indicate that, even though the use of radiant baseboard resulted in warmer air near the floor and in warmer inside surfaces for the exposed walls, in order to produce the same degree of comfort it was necessary to maintain the same air temperature at the 30-inch level with the radiant baseboard as was required with the conventional recessed radiators. Hence, the main advantage of the radiant baseboard lies in the fact that warm floors will be obtained.

Floor Slab Temperatures: An analysis of the data on the study of floor slab temperatures in the basementless house further substantiates the ability of radiant baseboard to maintain warm floors. Fig. 11 shows the points at which surface temperatures and temperatures 2 inches below the surface were measured. It is to be noted that the temperatures measured in the living room would be representative of slab temperatures existing in any plane perpendicular to a wall at a point where radiant baseboard was located, while the temperatures measured in the kitchen would be fairly representative of slab temperatures existing in any plane perpendicular to a wall at a point where no radiant basebobard was located.

Fig 15 shows the variation in the temperatures of the surface of the floor slab in the basementless house over the range of indoor-outdoor temperature differences encountered during the 1947-48 heating season. Temperatures 2 inches below the slab surface remained within 2 degrees of the surface temperature directly above. The thermostat, located 30 inches above the floor on the east wall of the

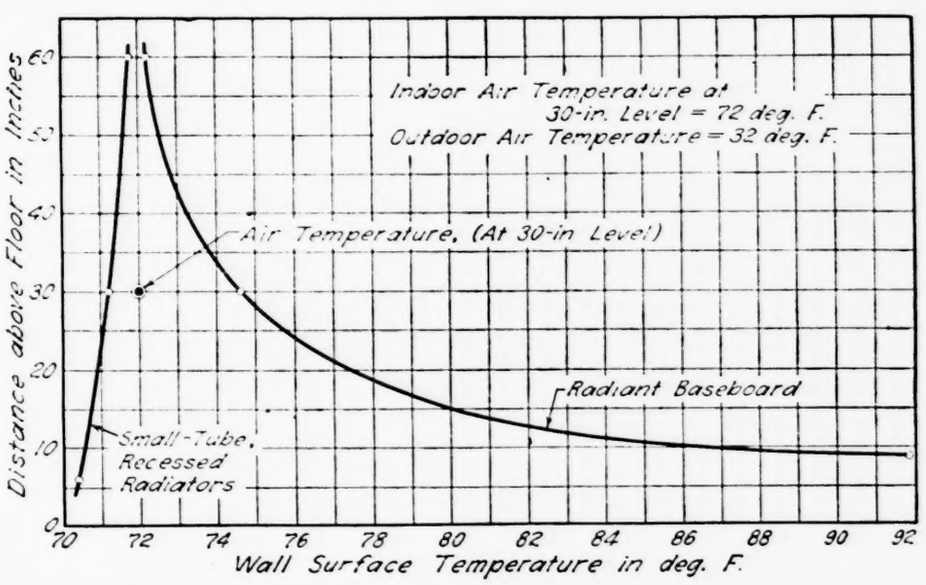


Fig. 14. Inside wall surface temperatures, north wall of living room in I=B=R Research Home.

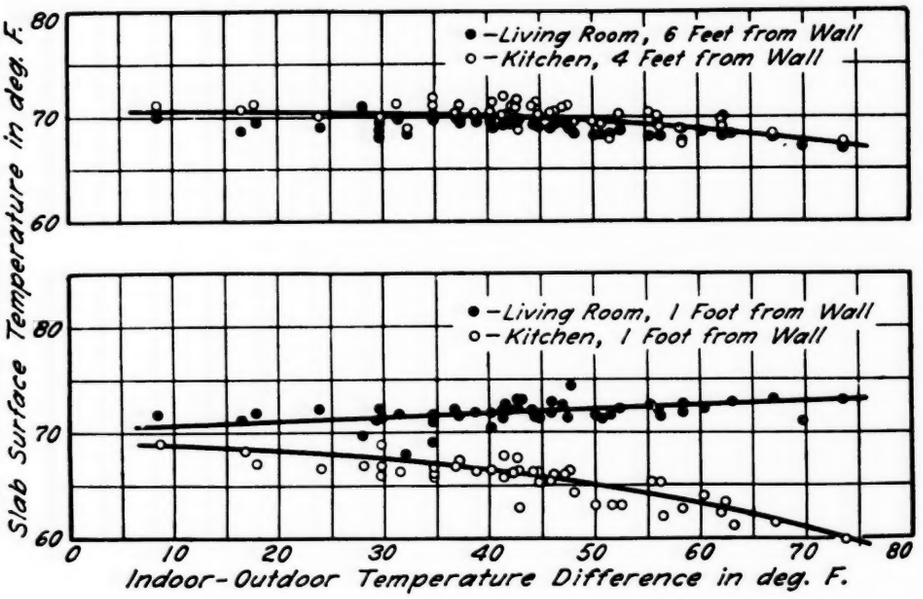


Fig. 15. (Left) Slab surface temperatures.

living room, remained set at 72F the entire heating season.

The upper curve in Fig. 15 shows that essentially no difference existed between the average surface temperatures of the floor slab at the approximate centers of the living room and kitchen. Further examination of this curve shows that average surface temperatures at the centers of the kitchen and the living room remained practically constant at 70.5F over the range of indoor-outdoor temperature differences from 0 to 40 degrees. For indoor-outdoor temperature differences greater than 40 degrees, the average surface temperature at the center of the room decreased approximately 1.0 degree for each 10 degrees increase in indoor-outdoor temperature difference. Thus, at the design condition of 80 degrees indoor-outdoor temperature difference, the average surface temperature in the center of the room would be about 66.5F.

The lower curves in Fig. 15 show that slab surface temperatures, one foot from the west wall in the living room and one foot from the north wall in the kitchen, were markedly different. As a result of higher water temperatures in the heating system in the colder weather, the floor surface temperature in the living room increased slightly as the indoor-outdoor temperature difference increased. The average surface temperatures one foot from the wall in the living room were 70.5F and 73.0F for indoor-outdoor temperature differences of 10 degrees and 70 degrees, respectively. In the kitchen, floor temperatures measured one foot from the north wall were influenced primarily by outdoor and indoor air temperatures. Hence, as the indoor-outdoor temperature difference increased, the surface temperature decreased. Average surface temperatures of 68.8F and 61.0F were obtained one foot from the wall in the kitchen at indoor-outdoor temperature differences of 10 degrees and 70 degrees, respectively. It becomes obvious then that if "cold floors" are to be eliminated in a structure of this type by the use of radiant baseboard, the baseboard should cover a large percentage of the outside wall exposure.

In the living room, the temperature of the slab near the outside walls was higher than the temperature of the slab near the center of the room, indicating a net heat flow in the slab toward the center, rather than toward the edge. However, in the kitchen, along a section of wall where no radiant baseboard was used, the slab temperatures decreased from the center of the room toward the exposed

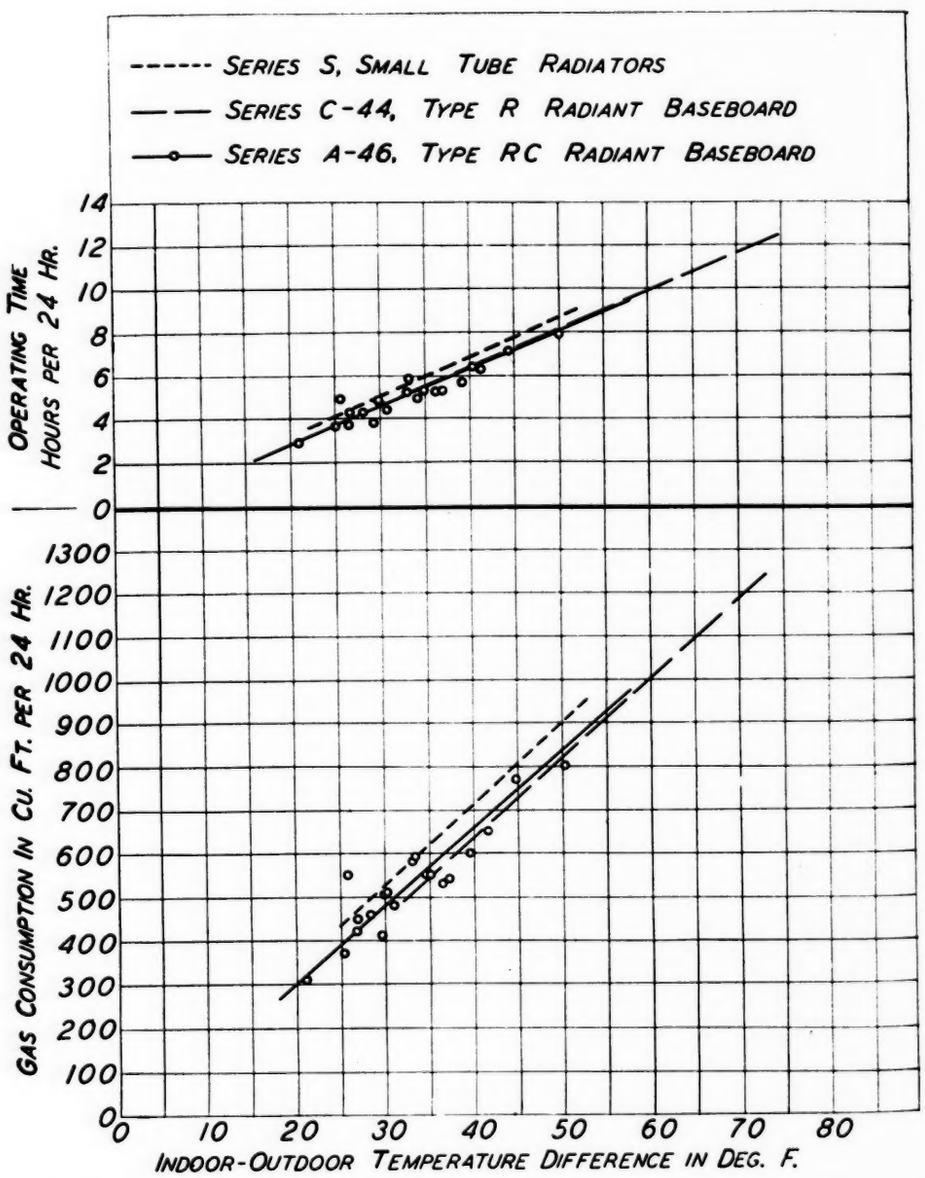


Fig. 16. Burner performance curves, three types of radiation in the I=B=R Research Home.

edge, indicating a heat flow towards the edge of the slab. It was also noted that the temperature drop across the edge insulation was the same in the living room as in the kitchen. As this temperature drop is an index of the heat transmission through the insulation to the outdoors, it is evident that the presence of the radiant baseboard in the living room did not increase the heat loss through the edge of the slab.

Fuel

Fuel Consumption: In the preceding discussion, it has been pointed out that as far as the production of comfort is concerned, both type R and type RC radiant baseboard proved to be equal to or superior to the small-tube radiator. Nothing was said as to the comparative cost of operation. The fuel consumptions obtained in the Research Home with the three types of radiation are shown in Fig. 16. Test points other than those for the type RC radiant baseboard have again been omitted for the sake of clarity. It may be observed that replacing the conventional radiators with either type of radiant baseboard resulted in a reduction in fuel consumption of approximately 5 to 8%. However, primarily due to differences in the basement piping for the different heating systems, an air temperature of about 70F was obtained at the basement ceiling during the tests using radiant baseboard as compared with a temperature of approximately 75F obtained during the tests of the small-tube radiators. It is probable that the decrease in fuel consumption should be attributed to this 5-degree decrease in basement temperature. In any case, variations in the effect of wind and sunshine are liable to result in deviations of as much as 5% from the averages of the fuel consumptions represented by the plotted curves. For this reason, differences in the order of magnitude of those shown in Fig. 16 cannot be regarded as significant, and to all intents and purposes the fuel consumptions obtained with the radiant baseboards and the conventional recessed radiators can be considered as practically the same.

Cleanliness of Operation: Immediately after installing the radiant baseboard in the Research Home and before any heat was required, all the walls were painted and all curtains and draperies were cleaned. After operating through a complete heating season of approximately nine months with type R radiant baseboard, no dirt patterns were observed on the walls above the radiant baseboards and there was no evidence that the heat had discolored the paint on the wall. Furthermore, at the end of the heating season, the white curtains at the windows over the radiant baseboards were as clean as were similar curtains at windows under which no radiators were located. Neither were in need of cleaning.

After operating through a complete heating season of nine months using type RC radiant baseboard, faint dirt patterns were discernible on the walls above the units in several rooms. It was observed that the patterns were more pronounced in the kitchen and in the SW bedroom. In these rooms, no rugs were used on the floors. Characteristic dirt patterns appeared on the walls above the conventional recessed radiators, and the curtains above these radiators were in need of cleaning long before the end of the heating season.

Dirt patterns are the result of dust being carried close to the walls by convection currents and being deposited by thermal precipitation. Thus, the design of the radiator should be such as to direct the convection currents away from the wall. Also, the less the convective heat output of the radiator, the less the tendency to produce dirt patterns. For any given design of radiator, the convective output is related to the temperature of the radiator; and it was found that for the types of radiant baseboard tested in the Research Home, there was little dirt streaking of walls when average radiator temperatures not exceeding 200F were used.

Heat and Moisture Transmission

Since the occupant of a room is subjected to the radiant effect of his surroundings, the surface temperatures of the exposed walls and of windows assume an important role in the degree of comfort he experiences. The inside surface temperatures of walls and windows are influenced by the temperature of the air in the room, the temperature of the outdoor air, indoor and outdoor air movement, the thermal resistance of the wall or win-

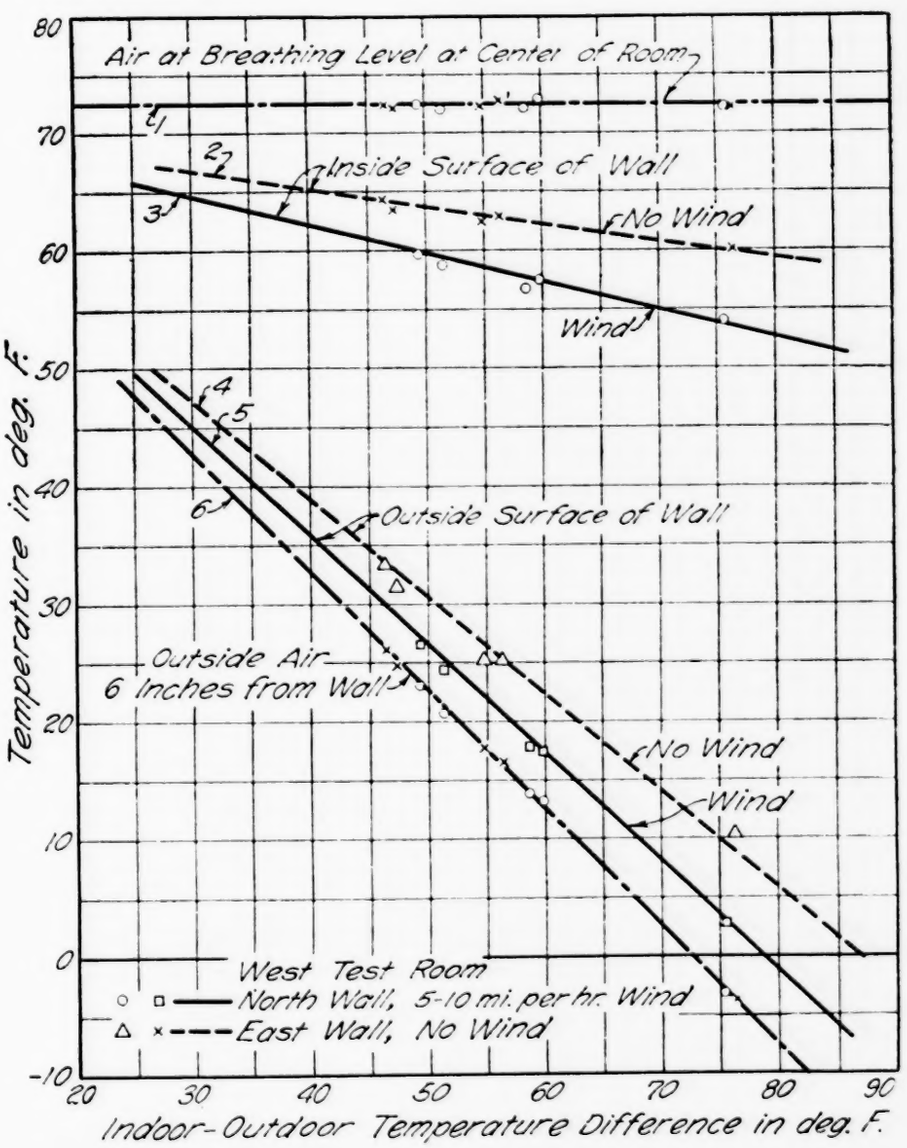


Fig. 17. Temperatures of wall surface and of inside and outside air.

dow, and the type and location of the heating unit.

Heat Transmission Through Uninsulated Walls

The effect of both air movement and temperature of the outside air on the temperature of the inside surface of an uninsulated frame wall (3) is shown in Fig. 17. These temperatures were observed in the low temperature testing plant where the air temperature at the breathing level was held constant at 72.5F by means of a radiator located under the window along the north wall. The east wall of the test room was not subjected to any wind, while a simulated wind of from 5 to 10 miles per hr velocity was directed against the north wall.

When the outside temperature dropped from 45.0F to —2.5F the temperature of the inside surface of the east wall decreased from 67.0F to 60.0F, and the north wall, from 65.0F to 54.0F. Thus a drop in outdoor temperature of 47.5 degrees resulted in a drop of 7 degrees in the temperature of the inside surface of the wall in the case of the east wall and of 11 degrees in the case of the north wall. The effect of a constant air movement of 10 miles per hr was to reduce the temperature of the inside surface over a range of from 2 to 6 degrees, the greater reduction accompanying the lower outdoor temperature. Hence, it is evident that both a drop in outdoor temperature and an increase in air movement cause a reduction in the temperature of the inside surface of the exposed walls.

If the occupants were just comfortable when the outdoor temperature was 45.0F and the temperature of the inside surface of the wall was 67.0F they would not be as comfortable when the outdoor temperature dropped to —2.5F and lowered the surface temperature to 60.0F. They probably would be decidedly uncomfortable if an additional air movement now further reduced the inside surface temperature to 54.0F as previously indicated. Since almost without exception the temperature difference between the floor and the upper limit of the occupancy zone increases with decreasing outdoor temperature, it becomes evident that a reduction in the temperature of the air near the floor will usually accompany the reduction in wall surface temperature. Hence, the indication of an air temperature of 70.0F or higher at the thermostat location may not be a true criterion of the comfort of the occupants, the assertions of discomfort may be entirely justified. This may naturally result in too much emphasis being directed toward condemnation of the heating plant, rather than toward conditions external to the plant itself.

The most effective way of eliminating discomfort resulting from cold wall and glass surface temperatures is through the use of insulation and storm sash. This will not only increase the surface temperature but it will also decrease the air temperature gradient between the floor and the upper limit of the occupancy zone. Locating the thermostat at the 30-inch level rather than at the 60-inch level helps to maintain more uniform indoor temperatures over the entire occupancy zone regardless of outside temperatures. For this reason the 30-inch level is preferred for the thermostat location, especially in uninsulated houses where the spread between the air temperatures at the 60-inch level and the floor may be quite large, particularly during periods of low outdoor temperatures.

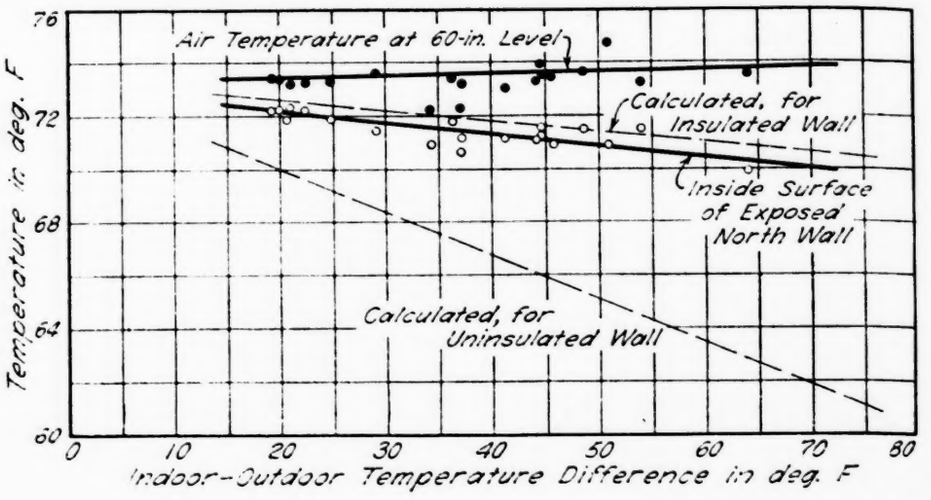


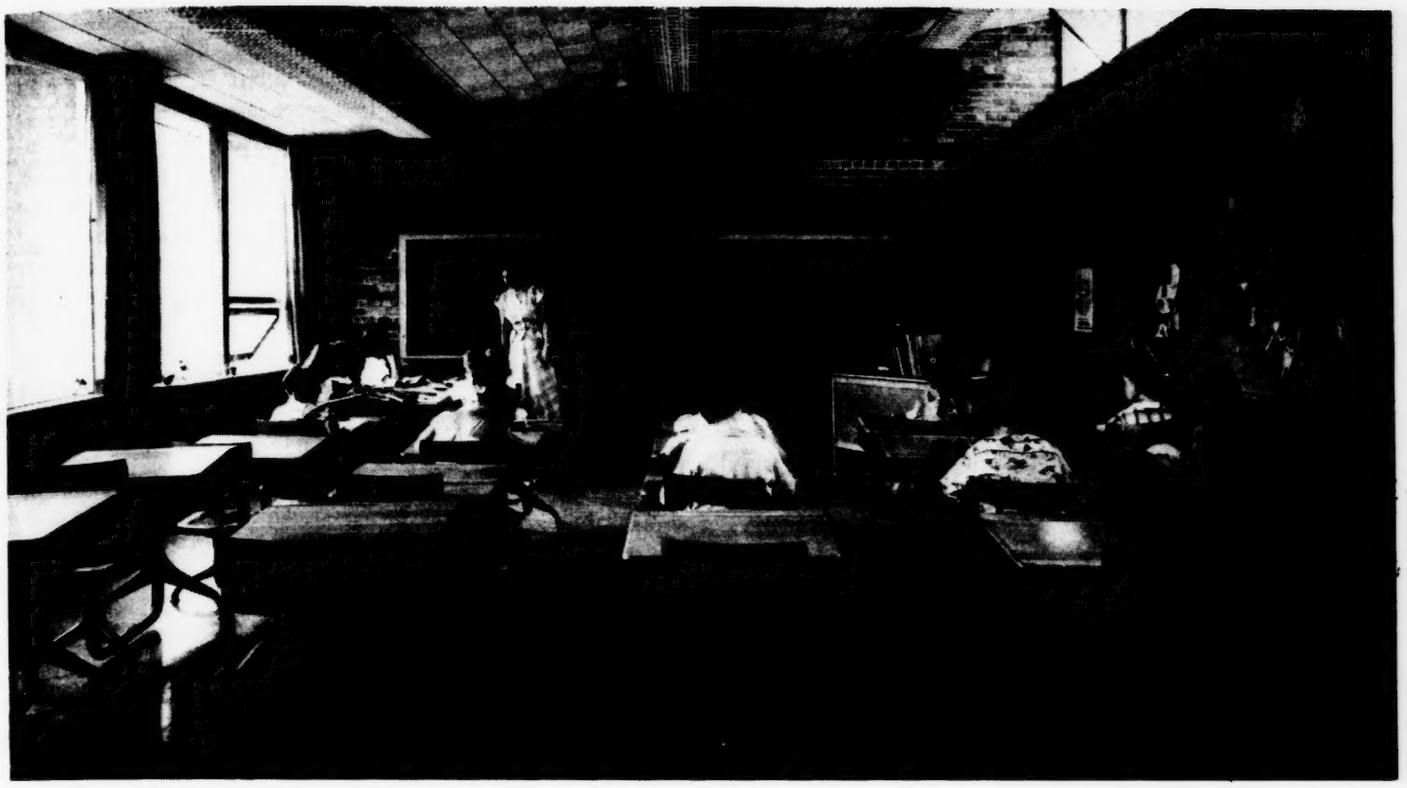
Fig. 18. Air and inside wall surface temperatures in living room of I=B=R Research Home.

Heat Transmission Through Insulated Walls

Since, for a given outdoor temperature, the temperature of the inside surface of the wall is also dependent on the type of wall construction, the conditions discussed in the previous section serve to emphasize the necessity for adequate wall construction from the standpoint of heat transmission, particularly in the colder climates and in those with prevailing high winds. Also, of increasing importance are the economics of effective heat conservation. No matter how efficient the heating system is, if the building is poorly constructed and leaks heat rapidly, a large quantity of heat must be generated, and the heating cost will be high as compared to the same building adequately insulated (6).

Fig. 18 shows the observed temperatures of the air at the 60-inch level in the living room of the Research Home and of the inside surface of the north wall at the same level, plotted against indoor-outdoor temperature difference. Curves showing calculated temperatures of the inside surface of the actual insulated wall and of a similar brick veneer wall without the 3⅝ inches of insulation are also included. It may be observed that the actual temperature of the exposed wall decreased somewhat as the outdoor temperature decreased, and that at an indoor-outdoor temperature difference of 72 degrees, corresponding to an average outdoor temperature of zero, it was only 3.8 degrees lower than that of the air in the room. Furthermore, a very close agreement was obtained between the observed and calculated temperatures of the inside surface of the actual insulated wall. The curve of calculated temperatures for the uninsulated wall shows the temperatures that might have been expected if the insulation had been omitted from the walls of the Research Home. Under these conditions the probable temperature of the inside surface in zero weather would have been 61.5F or 12.2 degrees below the temperature of the air in the room. That is, the presence of the insulation apparently increased the temperature of the inside surface of the exposed wall an amount of the order of 8.5 degrees. Also, temperatures observed in a cross-section of the north wall of the house over a period of a day showed that the temperature of the inside surfaces remained practically constant irrespective of the daily changes occurring in the outdoor temperature and in the temperatures of the outer layers of the wall. Thus, in addition to the fuel savings resulting from the lower heat transmission of the insulated wall, the higher surface temperatures produced are of considerable importance from the standpoint of decreasing the heat loss from the body by radiation and of minimizing any tendency for cold floors brought about by downward currents of cold air resulting from the presence of cold wall surfaces.

Part 2 of this article, to be published next month, will cover heat transfer through glass and radiator recesses, humidity in houses, domestic hot water, etc.



Convection heating is used under the large windows in the Clyde L. Lyon Elementary School, Glenview, Ill.

Convection Heating for Schools

E. A. CLINE

Manager, Convector Sales, The Trane Co.
La Crosse, Wis.

This is the third of a group of articles dealing with the subject of suitable heating systems for school buildings. Each article, by a different engineer-specialist, covers a specific heating system satisfactory for schools.

THE current and unprecedented school building boom in the United States has focused attention of engineers and architects on the problems involved in properly selecting heating systems for schools.

Special problems inherent in the operation of the school building must be solved in addition to most of the routine difficulties that confront the heating designer engaged in residential, commercial or industrial heating.

Foremost among these problems is safety. No compromise should be made with absolute safety from fire, explosion or asphyxiation when from 200 to more than 1,000 children assemble under one roof. The tragic New London, Texas, school explosion of 1937 demonstrated the danger of makeshift heating systems fundamentally unsound for school purposes. Minor accidents also merit attention. Hot surfaces and rigid edges and corners often cause serious burns and bruises to active children crowded in corridors, stairways or classrooms.

Guarding the health of every school child is another problem. The well-designed modern school heating system minimizes the spread of contagion throughout the school by providing each room with its own source of heat and ventilation, rather than recirculating germ-laden air throughout the building. Even temperatures in all parts of the classroom and a blanket of warmth at the windows also contribute to the health of the children in the room.

Rapid Heating Needed

Safety and health are not the only special considerations in designing the modern school heating plant.

Inherent in the nature and use of the school building is intermittent occupancy during the day. Most school buildings need heat only during a short day, say from 8:30 a.m. until 3 p.m. Large window areas and frequent lack of adequate thermal insulation result in exceptionally large heat losses. Most school

A convector is concealed behind the settee in the lobby of the Blythe Park School, Riverside, Ill.

houses are allowed to cool to relatively low temperatures at night. In the morning the entire building must be reheated quickly; often individual classrooms, auditoriums, gymnasiums and libraries must be heated specially for use by community groups, several in the evening.

Still other problems are posed by modern trends in school design. Emphasis on large window areas, often on two sides of the room, to insure maximum, even daylighting in the classrooms, has increased the heating problem. These large window strips are alternately heated by the sun and cooled by northerly winds to place additional loads on the heating system. The modern heating system must be capable of blanketing icy windows with heat, or shutting off this heat when the sun's radiant rays send room temperatures soaring.

Popularity of the one-story or California ranch type schools has spread even to the midwest and the northeast. These rambling buildings offer significant educational advantages as well as rapid emergency evacuation. Transmission of warm air through excessively long ducts for these long buildings can prove costly and wasteful.

Only one heating system can satisfy all these special school requirements, successfully and economically. This is a hot water or steam system employing the various flexible forms of convection heating equipment as required.

Convector System Safest

Fire and explosion risks are minimized with a well-designed hot water or steam convector system, since the heat source and fuel are confined to a central boiler room designed to contain any fire or explosion likely to develop. Gas lines do not run from room to room as they did at New London, Tex. There are no ducts to help circulate smoke, noise or germs. Heat is circulated throughout the school building by easily insulated pipes of hot water or steam systems.

The basic design of the modern convector protects the children from burns, bruises and cuts.

The fin and tube heating element is generally concealed in a free-standing, recessed or semi-recessed cabinet of smoothly rounded heavy gage steel. Convection currents induced by properly placed heating elements rapidly diffuse warm air to all parts of the room without overheating the exposed surface of the cabinet. Connecting pipes are usually completely concealed or insulated, eliminating entirely the danger of contact burns.

Convectors located at windows provide a warm blanket of air at the point of greatest heat loss and induce rapid and continuous circulation to every part of the room. This rapid circulation minimizes the radiant effect of the heating units and eliminates the torrid zone near the unit. In this way, children sitting near the convectors enjoy the same even temperatures as those in remote parts of the classroom. This distribution of controlled heat tends to reduce the opportunities for colds.

With a wet heat convector system of heating, each classroom has its own independent heat source. No air is circulated from room to room. Ventilation is provided as required, either from unit ventilators or from windows.

Flexible Controls Add to Health Advantages

Complete flexibility is the characteristic that gives conventional convector systems an ideal rating for school heating.

Air circulation, temperature and control requirements vary widely from gymnasiums and auditoriums to kindergartens where children play on the floor. With the hot water convector system, the building engineer can tailor heat and ventilation to suit the requirements of each room in the building.

Active children in the gymnasium or shop require a lower ambient temperature than do those in a classroom. Both rooms may be used intermittently, and occasionally for evening activities. A generally accepted solution to the heating system for these rooms is the unit heater, which combines the extended fin heat transfer surface of a convector with a propeller

Teachers' lounge in the Primary School, Deerfield, Ill.

fan. The projection type unit is mounted near the ceilings of many post-war gymnasiums—from the children's playroom of the elementary school to the large high school field house.

Convector radiators or wall-fin type radiation in bleachers, entrances, hallways, locker rooms, shower rooms and athletic offices operate from the same circulating hot water system. Each area has its own temperature controls for properly sized units. Thus children moving from athletic to sedentary activities are assured even, comfortable and healthful temperature and proper air circulation at all times.

Convectors and/or wall-fin radiation provide quickly responsive floor level heat where required, whether in auditorium, foyer, stage or dressing rooms.

The hot water system's flexibility extends to the other end of the scale, in the kindergarten. Here the children play games, gather in story circles, and take naps or rest periods on the floor. Experience has demonstrated that a well-designed convector or continuous strip wall-fin radiation heating system provides warmth at floor level throughout the kindergarten.

Some school architects have sought to guarantee warm floors for the kindergarten children by use of a floor panel heating system. Drawbacks of the panel heating system used alone include its slow response to temperature change, its failure to meet the fundamental requirement of rapid heating for the school's intermittent use, and the fact that a floor temperature warm enough to heat the kindergarten room is too warm for the comfort of children playing or napping on the floor.

The hot water system properly designed with convection circulation fulfills the basic requirements of safety, flexibility and rapid response.

The Convector in the Classroom

The complexity of school heating problems in classrooms and special purpose rooms has pointed up the need for flexibility and rapid response to heating demand. An ideal heating system is of special importance to the classroom—where children spend more hours, under closer confinement, than in any other room. The modern convector hot water system is completely at home in the model classroom.

The best contemporary school designs feature maximum daylighting. Light steel or aluminum mullions and strip windows that run the full length of the classroom from wall to ceiling are found in the newest schools. Daylighting from both sides is assured by clerestory windows above the inboard corridors. While this large window expanse has its advantages, it also contributes to the complexity of school heating.

School construction budgets seldom include double-pane insulating windows or storm windows. Within a few minutes, a cloud mass can convert a sunlit window from a generous solar heat inlet to a wasteful heat outlet. Adequate heat, in a hurry, without overheating, must be provided. In other words, the heating system must be completely and immediately responsive.

No other heat transfer surface can compare with the non-ferrous extended surface coil in rapid response and continued efficiency. The properly controlled convector assures an immediate source of closely modulated heat and circulation through the classroom, whatever its design.

Children's playroom in the Clyde L. Lyon Elementary School.

The individual school heating system can have the plus advantages of controlled ventilation and filtered air with convectors combined with unit ventilators from the same manufacturer.

Economy with Convectors

The layman might question whether a system suited so well to the complex requirements of the modern school can be economical. Since no price tag can be placed on the health and safety of school children, these considerations should not enter cost discussions.

The real, lasting economy of the convector system is in its low maintenance and operating costs. The even heat distribution of the convector makes possible lower temperatures at the heating source and consequently lower operating and fuel costs. It is not necessary to overheat one part of the room to bring a remote corner to a comfortable temperature. There is no need to heat an entire building to keep open one classroom or gymnasium.

Rapid response of the convector to heat needs also saves fuel. The units can be turned on relatively late in the morning, delivering heat quickly and using little fuel in the starting-up process as compared to massive cast iron radiators. Cut off at the end of the day, the non-ferrous convectors cool rapidly, further reducing waste heat and fuel.

The convector delivers heat only when needed and where it is needed, controlled to varying conditions of sunshine and cold and changing occupancy.

Even the initial cost is low. Convectors cost less than cast iron radiators. Convectors are light and compact enough for one man to handle and install, so both shipping and installation costs are lower. Smooth metal cabinets may be painted or repainted at much lower cost than cast iron radiators or warm air grilles.

These considerations—health, safety, economy of installation, operation and maintenance, space, flexibility, and quick response to changing conditions and control—have contributed to the amazing acceptance of the convector as the all-purpose heating unit for school use.

Scrapbook of Exhaust Hood Design

Part 3—Control of Dust from Cast Iron Machining

JOHN M. KANE
Chief Engineer, Dust Control Division, American Air Filter Co., Louisville, Ky.

CONTROL of cast iron machining dust has received increasing attention by plant engineers as machining speeds have become higher and the use of multiple operation machine tools has increased the concentration of fine dust generated per unit of floor space. Outstanding improvement in cleanliness of worker and workroom has resulted in the removal of fine floating cast iron dust by the existing local exhaust methods.

Normally, no effort is made to remove chips generated by such operations although some chips will be removed by the exhaust air. The quantity is dependent on the location and design of the exhaust hood. Hood design is often a compromise between the desired hooding around the source of dust release, and a remotely located hood necessary for visibility by the operator, movement of the machine tool parts, and the placing or removal of work. Fortunately, the dust concentrations involved and their small particle size permit their deflection to the exhaust hood without noticeable escapement when modest exhaust volumes are employed.

Hood designs will be as varied as the machine tool, the part finished, and the operation performed. Usually small hoods with face velocities of 400 to 2,000 fpm can be designed and properly located, after watching the machining operation and the point of dust released. Branch sizes of 4 to 6 inches, exhausting 400 to 800 cfm, will be sufficient. At times it will also be possible to enclose much of the open area, as shown in Figs. 2, 3 and 4, and determine the exhaust volume required to maintain an indraft of 100 to 150 fpm in through the remaining openings.

Hoods for cast iron machining operations, Fig. 1 through 7, will indicate hood shapes and typical exhaust volumes that have proved effective for the machine tools and the operations described. They should suggest suitable treatment, hood shapes, and exhaust volumes required for similar operations in this field.

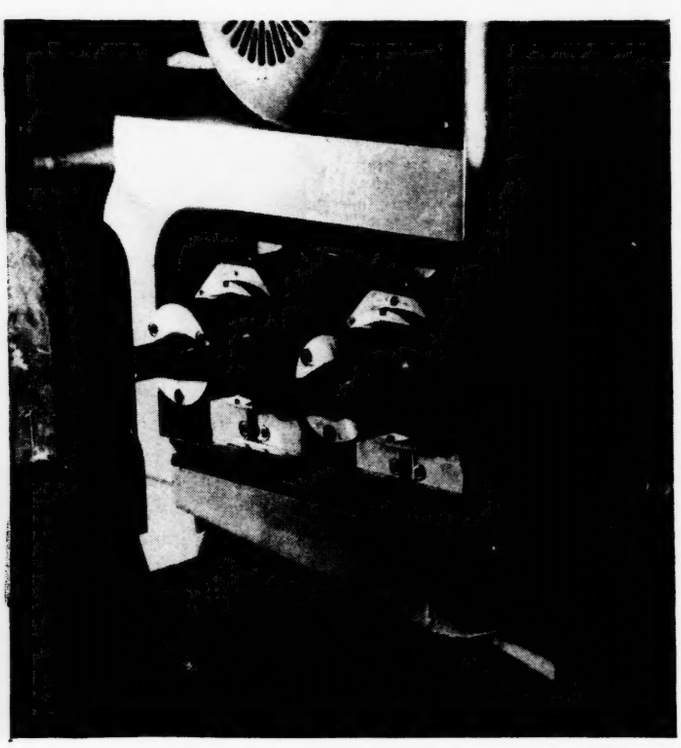


Fig. 1. This Ex-Cell-O boring machine has one 4-inch branch duct with an exhaust volume of 400 cfm.

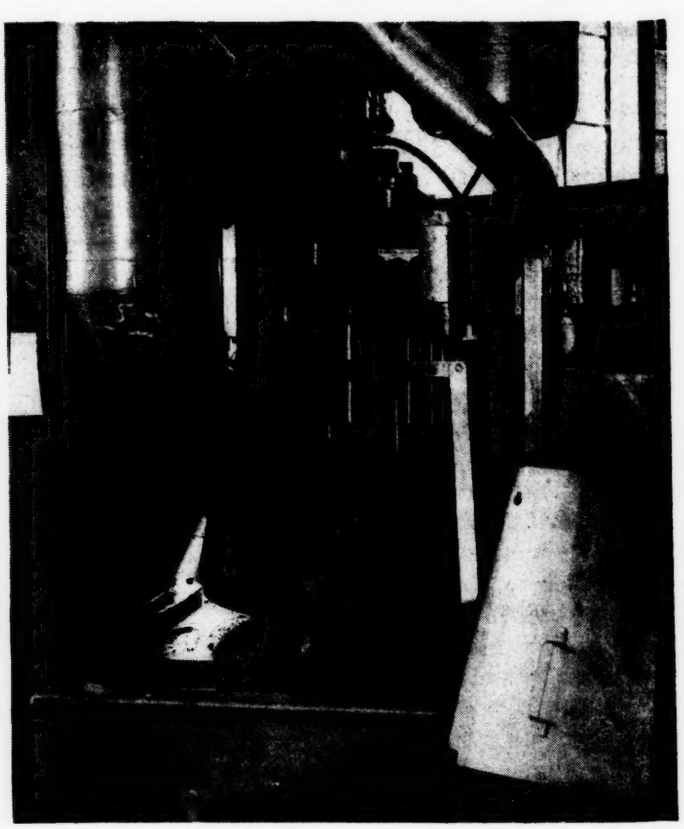


Fig. 2. One 12-inch branch with an exhaust volume of 3,500 cfm serves this Rehnberg-Jacobson to mill, drill, counterbore and ream.

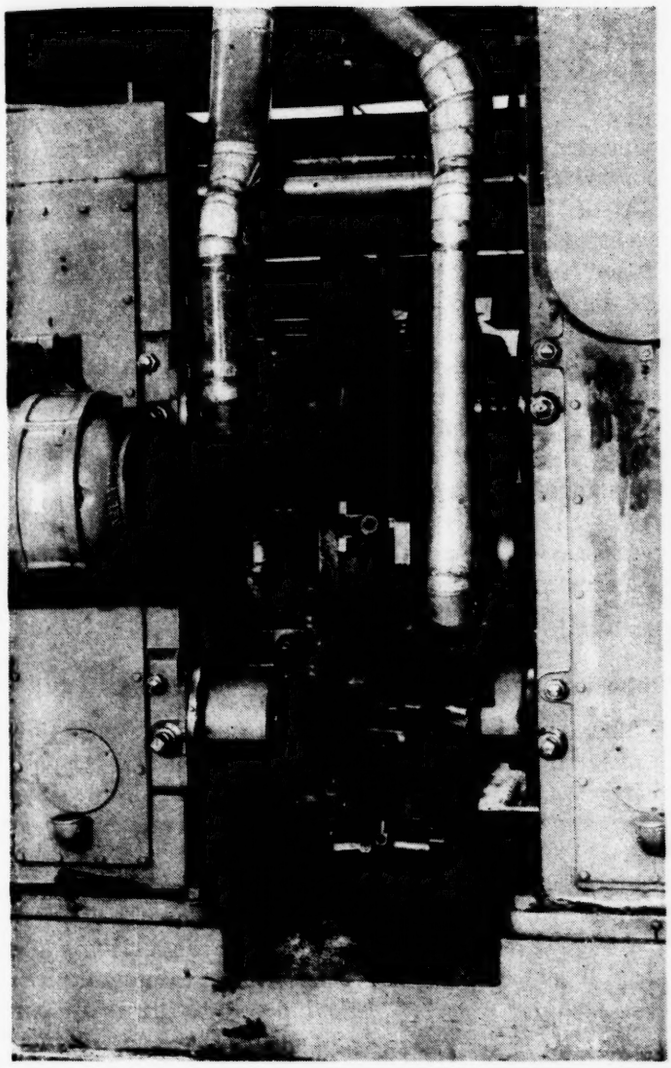
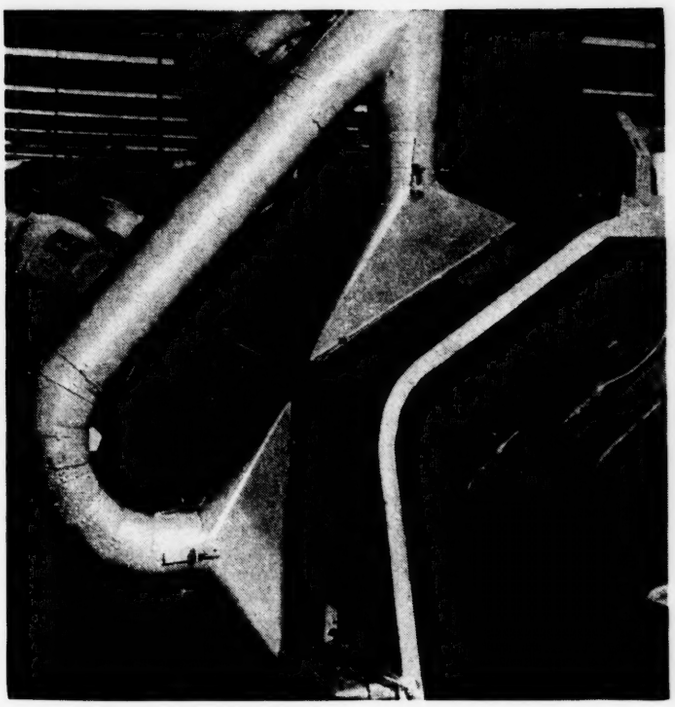


Fig. 3. Four 4-inch branches serve this Davis & Thompson gang mill and remove 1,600 cfm.

Photographs courtesy, Oldsmobile Division, General Motors Corp., Lansing, Mich.

Fig. 4. An Ex-Cell-O Special, used in drilling, reaming, counterboring and tapping, has two 5-inch branches for removing 1,200 cfm.



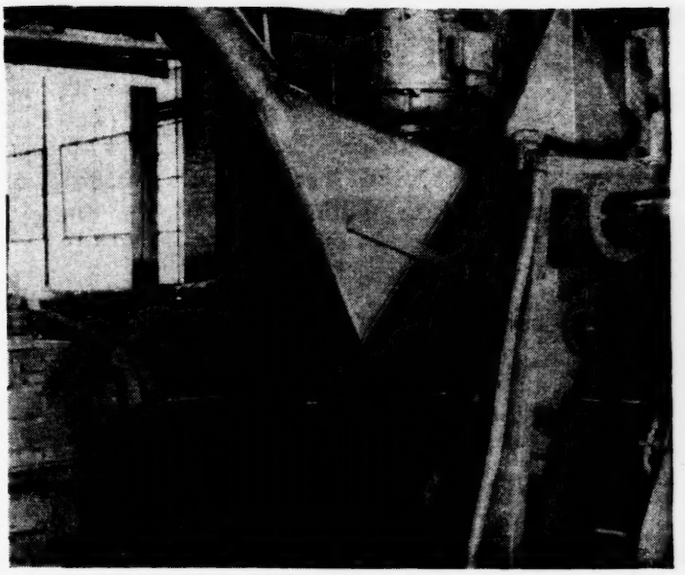


Fig. 5. One 6-inch branch (900 cfm) is used on this Ex-Cell-O drill for drilling, countersinking and reaming.

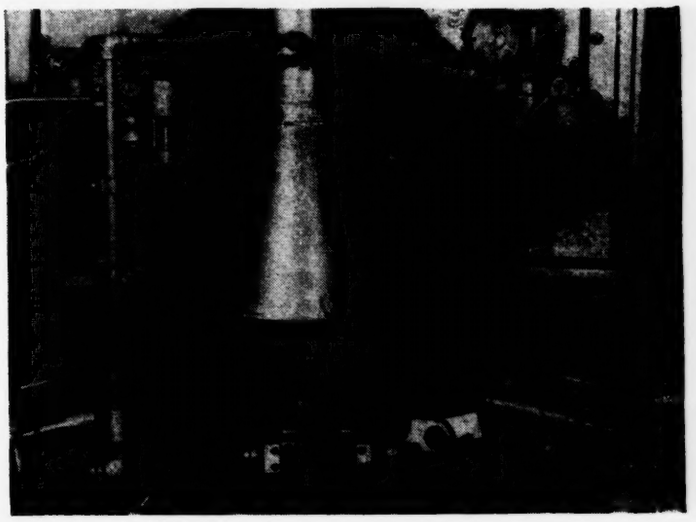


Fig. 6. A Kingsbury 20-inch automatic index drill, drilling rocker arms, uses an 8-inch branch and 1,600 cfm.

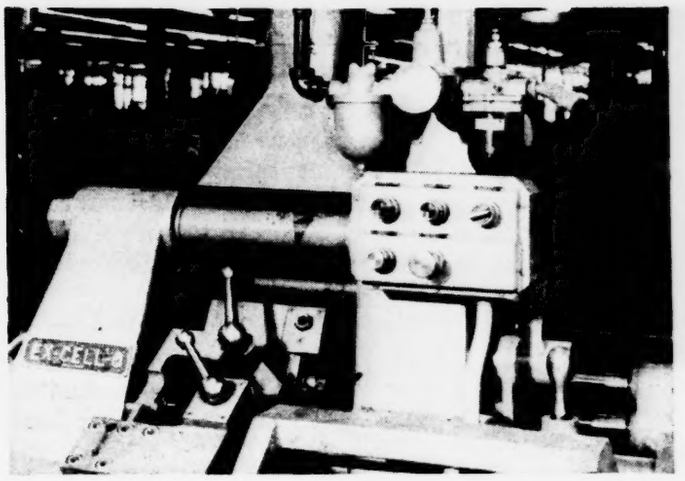


Fig. 7. One 7-inch branch exhausting 1,200 cfm serves this Ex-Cell-O boring machine used for drilling, tapping and counterboring.

Space Heating with Solar Energy

Brief abstracts of papers presented at a 5-day symposium held at the Massachusetts Institute of Technology on house heating through solar energy.

MORE than 200,000 times as much energy falls on the earth from the sun than man knows what to do with. This startling statement was made by George R. Harrison, Dean of Science, Massachusetts Institute of Technology in opening the symposium on Space Heating with Solar Energy that was held at M.I.T., August 21 to 26, attended by 100 engineers from all over the United States. The gathering was sponsored by the Space Heating Committee of the Cabot Solar Energy Research Project. The fund for this work was established 13 years ago by Dr. Godfrey Cabot.

Studying the operation of the Solarometer for depicting angle of sun's rays. Left to right, Prof. L. B. Anderson and Dr. Maria Telkes of M.I.T., and Dr. W. J. Arner of Libbey-Owens-Ford technical staff.

Morning sessions consisted of the presentation of fundamental background material by members of the M.I.T. faculty and the afternoon sessions were devoted to reports on current solar heating developments by specialists in the field.

The introductory lecture was given by Hoyt C. Hottel, professor of fuel engineering, Department of Chemical Engineering. He stated that the solar energy falling on one square mile of the earth's surface in one day is equivalent to the energy in two atom bombs, based on what we know of the atom bombs exploded in Japan.

Conclusions of studies indicate that solar houses in New England must (1) be unusually well insulated, or (2) the collector must be larger or more efficient or (3) the climate must be milder or (4) auxiliary heat must be available.

In the Boston area, the householder is justified, on economic grounds alone, in spending somewhere between $1.50 and $3 per square foot of collector. However, many parts of the country have more favorable conditions for solar heating.

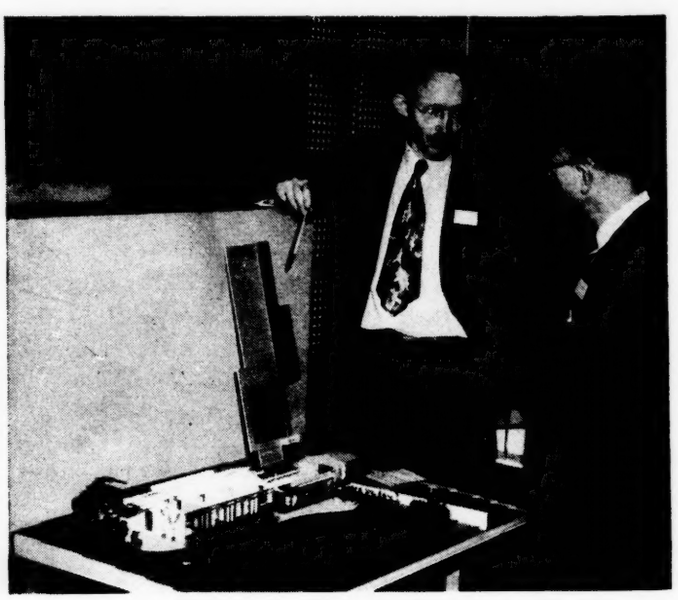
Prof. Lawrence B. Anderson, head of the Department of Architecture at M.I.T., and Chairman of the Space Heating Committee of the school's Solar Energy Research Project, in his talk on Variables Affecting Solar Incidence, said that while the intensity of solar radiation outside the earth's atmosphere is relatively constant, many variables affect the amount of energy received on a surface at ground level. Although horizontal incidence is important meteorologically, south-tilted surfaces are more favorable for collecting for space heating purposes. Diffuse radiation may be treated as a constant undiminished by tilt. Seasonal changes in declination bring variations in the length of days that are different for every latitude.

Importance of Solar Energy

The Importance of Solar Energy was discussed in a paper by Eugene Ayres, Gulf Research and Development Co. He stated that all of our energy now comes indirectly from the sun and we will be dependent upon the sun for our future energy.

Our reserves of fossil fuels are gradually being depleted. Every oil well that was discovered prior to 1940 has already passed its peak of production. The peak of oil production in the United States will probably come between 1957 and 1960. The increased consumption of oil and the decline of production will have to be compensated by an increase in the oil imported.

The production peak of U. S. anthracite coal has already passed and the production peak of first quality bituminous coal is likely to come within ten years. While coal reserves will last much longer than this, quality and quantity will both deteriorate thereafter. Therefore, it is not too early to get down to serious

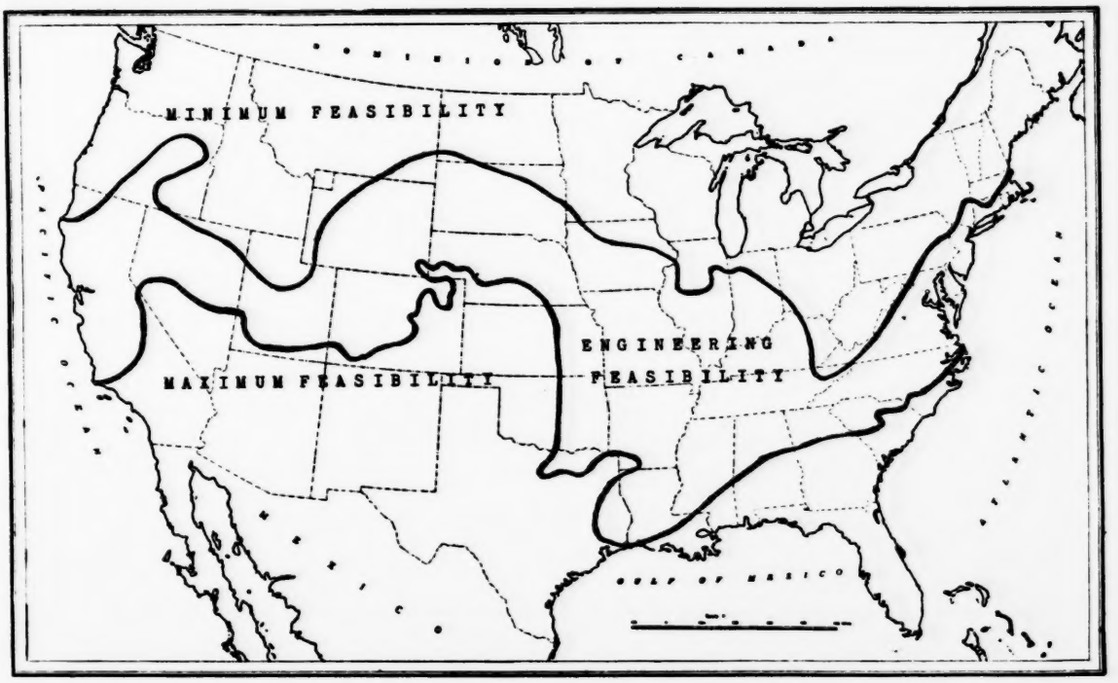


G. O. G. Lof, director of the Industrial Research Institute, University of Denver, uses his model to explain details of his partially sun-heated house to Prof. H. C. Hottel, M. I. T. chemical engineering department.

work regarding new technologies for solar energy utilization. It is probable that by the end of the current century we will have new technologies for solar energy utilization.

Aside from the simple production of heat by the absorption of the sun's rays, the most plausible conversion is in the production of electric power.

While enough technology is known now to guarantee an ample supply of energy in the future, continued research will steadily lower the cost of this energy.



Zones to indicate feasibility of solar heating systems in the United States.

Climatic Considerations

Solar heating of houses is not feasible for every section of this country. Dr. Paul A. Siple, military geographer, Chief Staff, U. S. Army, in his lecture on Climatic Considerations of Solar Energy for Space Heating, described his division of the United States into three zones, on the basis of the feasibility of converting solar radiation into space heating of buildings.

In the zone of maximum feasibility, heat requirements for evenings and the entire cool season can be supplied by solar radiation collection devices without expensive engineering.

The zone of engineering feasibility consists of an area where solar radiation can supply most of the heating needs of spring and fall, but will require special devices and careful engineering design to assure reliable and economical solar heating systems.

In the region of minimum feasibility, as illustrated, solar radiation is entirely inadequate for winter space heating with present engineering methods. As a supplementary heat source during late spring and early fall, and for sub-surface rooms during summer, it offers definite advantages in fuel economies and humidity control. In certain areas, even the most elaborate solar heating systems will require thermal support from summer heat pump storage systems.

Properties of Sufaces

Albert G. H. Dietz, professor of structural engineering, M.I.T., presented a paper on Diathermanous Materials and Properties of Surfaces. He covered the principles of radiation, emission, absorption and transmission of energy, and the application of these principles to properties of clear and opaque surfaces.

From the standpoint of solar energy collectors, the most important diathermanous material is glass, although transparent plastics offer possibilities. The per cent Fe_2O_3 present is important in determining the transmittance of the glass. If the iron content is low, the transmittance is high. There are not many data on the effect of dirt on the transmittance of glass. Measurements made at the M.I.T. solar house showed surprisingly small effects.

Although some plastics compare favorably with glass regarding transmittance over the entire solar spectral range and in the far infrared, there is relatively limited information available. Chief among the disadvantages of the use of plastics is doubt as to its long-time durability, tendency of many types to soften at temperatures likely to be reached in solar heat collectors, and low resistance to scratching and abrasion.

Flat Plate Collectors

A formula for the steady state performance of collectors was developed by Prof. H. C. Hottel during his lecture on The Performance of Flat Plate Solar Energy Collectors. This is the flat parallel plate-type consisting of one or more air spaced parallel glass plates mounted above and parallel to a blackened metal plate from which heat is removed by water or air. The mean temperature of the blackened plate is referred to as the temperature of heat collection. The optimum number of glass plates increases with increase in collection temperature and with decrease in solar intensity and atmospheric temperature.

Overlapped Glass Plate Collectors

George O. G. Lof, director, Institute of Industrial Research, University of Denver, Denver, Col., described a system in which a collector is installed on the roof, crushed rock is used as the heat storage bed, a fan operated for air circulation, and a duct system for conducting air between the units and the rooms.

The solar collector consists of a sheet metal trough

containing a series of single-strength glass plates arranged in a stair-step fashion, separated by ¼-inch spaces. Each glass pane is 24 by 18 inches. One end of each pane is blackened and each black surface is beneath two clear surfaces. Solar energy is transmitted through the transparent surfaces and is absorbed by the black areas. Air leaves at the upper end of the trough at a temperature approaching the black areas.

Solar Houses

The Design and Construction of Solar Houses was covered by George Fred Keck, architect, Chicago. The solar house should be designed to help organize the seasons — helping the heat in winter and stopping such heat in summer. Flexible devices are advisable for shielding the sun because of the lag of the seasons.

A number of slides were projected to show examples of solar house design by Mr. Keck.

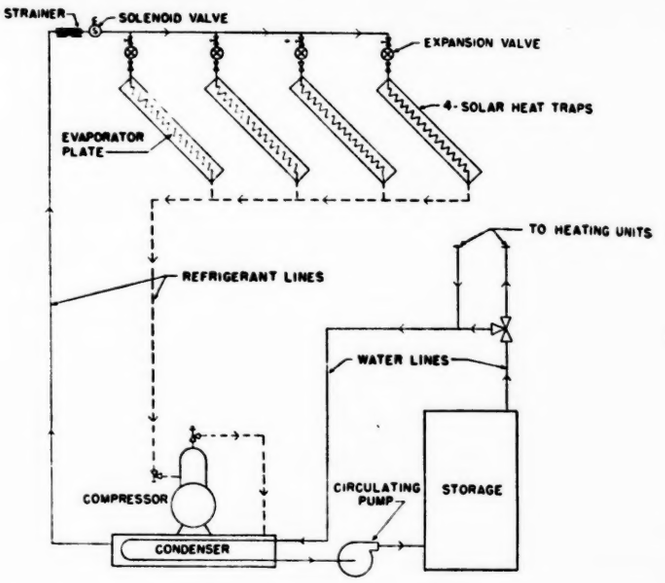
One session was devoted to the presentation of performance data on three solar houses. Performance of the M.I.T. house was presented by A. L. Hesselschwerdt, Jr., assistant professor of mechanical engineering, M.I.T.; Dover House by Dr. Maria Telkes; the study leading to the final design of a house using crushed rock for heat storage, by George O. G. Lof. In addition, Miss Eleanor Raymond, architect of the Dover house, described some of its construction features and told of the architectural problems that had to be solved.

Thursday Papers

Prof. L. B. Anderson described some of the architectural problems of the solar house. While south walls can be shaded by overhangs to increase the difference between summer and winter input, an overhang in a single fixed position is not the answer. Deciduous foliage more nearly provides an automatic correction for seasonal change. Double glass shows a reduction in the heat loss at night, and this can be further reduced by curtaining. The ratio of collector area to house envelope area is an important design factor.

The effect of the energy transport system upon the design of a solar collector was considered by Prof. A. L. Hesselschwerdt, Jr., in his paper, Energy Transport to Storage. He said an improper design of such a system, including collector circuits, can result in excessive power requirements per Btu collected. Formulas were developed for use in the necessary design calculations.

F. W. Hutchinson, professor of mechanical engineering, University of California, Berkeley, Calif., gave a report of recent research. He said that in latitudes 39-42° N, in an area east of Chicago, the average maximum savings in heating costs is $20 per 100 sq ft of vertical south-facing glass. This figure is based on electrical power at one cent per kwh, and a heating season of 5,088 hours. For San Francisco, this becomes $40 and for Bismarck, N. D., $12. The first cost of a solar house is necessarily greater than that for a house of conventional design. He developed a formula for the seasonal saving per 100 sq ft of window area.



Flow diagram for a solar heat pump system using evaporator plates and refrigerant lines.

Friday Papers

Prof. A. G. H. Dietz in his paper on Weather and Heat Storage Problems mentioned that there are now some 200 Weather Bureau stations throughout the United States. At some 34 stations measurements are made of the amount of solar energy falling on a horizontal surface. In designing, it is important to know the probable sequence of sunny days and dark days to determine the size of the heat collector system. The various types of heat storage media were described.

The use of air or water as the transport fluid results in different problems, depending upon the portion of the system under consideration. This was considered by Prof. A. L. Hesselschwerdt, Jr., in his talk on Engineering and Control Problems. Irrespective of the fluid used, the problem of utilizing solar energy for space heating and air conditioning demands the combined work of the architect and engineer.

A report on ASHVE Research on Heat Flow Through Glass and its Application to Space Heating by Solar Energy, was presented by George V. Parmelee, research associate of the ASHVE Laboratory. Overall coefficients of heat transmission were given for various types of glass and glass block walls. Application factors were stated for various types of windows. Heat gain from sunlit glass surfaces was discussed and heat flow curves given for single and double window panes.

E. R. Ambrose, air conditioning engineer, American Gas and Electric Service Corp., New York City, in a paper on Heat Pump System Employing Storage and Using Auxiliary Heat, showed the possibilities of storage and its effect on the system's delivery capacity. He discussed the heat of fusion principle for storage instead of water, auxiliary heating when using air as a heat source, and the use of storage heat traps in combination with a direct expansion refrigeration surface as a heat source. An experimental system was described.

During the symposium, time was provided for an inspection of the M.I.T. house on Memorial Drive, Cambridge, near the institute, and the house financed by Miss Amelia Peabody at Dover, Mass.

Methods for Supporting Pipe

J. E. YORK

Building Service Engineer, Stone & Webster Engineering Corp.

Part 5 of a group of articles that describes and illustrates the various means for supporting pipe lines. This article covers risers and vertical connections, hangers, sway braces, anchors and guides.

RISERS and vertical connections to equipment must be provided with adequate means of support to prevent excessive strain on flanges or screwed connections to equipment or on the horizontal pipe lines connected to the risers.

Base elbows supported directly on the floor or on concrete pads or steel are frequently provided where the direction of the run of piping changes from horizontal to vertical.

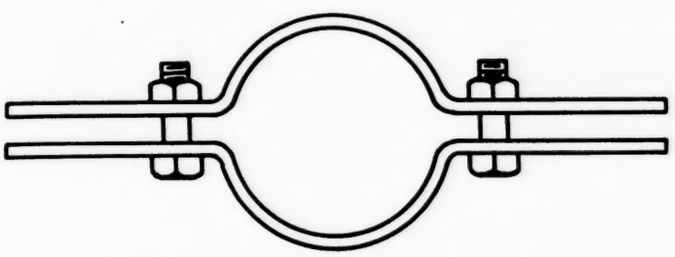


Fig. 85. Riser clamp with equal length legs.

Risers passing through one or several floors of a building require means of support independent of the horizontal mains which they serve.

Bell and spigot risers are frequently so installed that a bell end rests on a pipe sleeve where the pipe passes through the floor. It is not always necessary to provide support in this manner at each floor, but it is advantageous if it should be necessary to cut in a fitting or to replace a defective or damaged piece of pipe, to have the piping on each floor independently supported. In most cases it will be necessary to cut at least one section of pipe per floor to bring the supporting bells at the right level.

Small steel pipe risers not subject to appreciable expansion are sometimes supported in a similar manner by resting tee fittings for branch connections on the top of the floor sleeves.

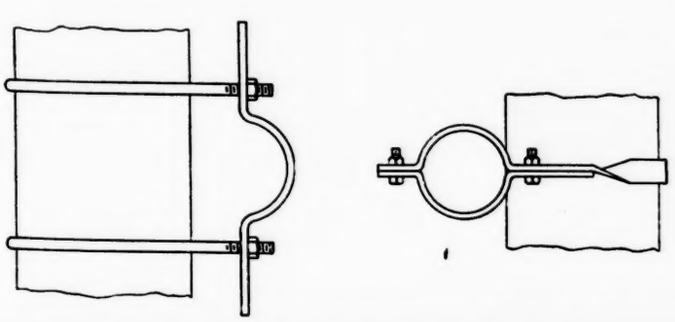


Fig. 86. Clamps for use with a floor beam.

Where the distance between floors is excessive, it may be necessary to provide intermediate supports for the risers, in order to insure their rigidity.

Riser clamps with legs of equal length, as shown in Fig. 85, are used where space will permit their installation. Riser clamps with legs of unequal length are frequently installed above the floor where their appearance is not objectionable.

Where the riser can be installed tightly against the flange of a floor beam, the riser clamp shown in Fig. 86 may be used.

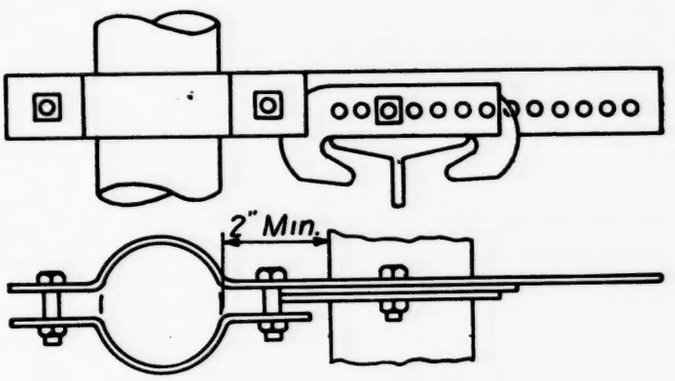


Fig. 87. Combination beam and pipe clamp.

The beam and pipe clamp shown in Fig. 87 may be used for risers which run close to but not tightly against the flange of a beam.

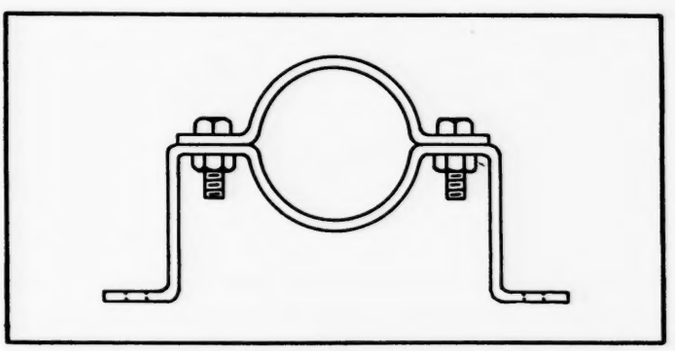


Fig. 88. Offset pipe clamp for intermediate support.

The offset pipe clamp shown in Fig. 88 may be used for intermediate supports to prevent the pipe swaying and may be fastened to steel columns or to the masonry structure.

In the early days of power station design and construction, steam at 200 to 250 lb per sq in. was classed as high pressure and the problems involved in supporting the piping were about the same as exist in a present-day industrial building using steam at these pressures. With steam pressures and temperatures that

are now common and with high rotative speed equipment, the stresses set up by expansion due to temperature changes, high pressures and vibration have made it necessary to provide suitable supports and anchors to offset or minimize their effects. Similar problems are encountered with feed water lines, exhaust lines, compressed air lines and oil lines.

Specifications for Supports

The specifications of one well known firm of engineers include the following paragraphs in relation to hangers, supports, guides and anchors:

"Hangers, supports, guides and anchors, whether or not indicated on the drawings shall be installed not only to care for the weight of piping with its contents, and insulation where required, but also to provide anchorage, guidance and flexibility for expansion and contraction where necessary, to provide the desired pitch of lines for drainage, to prevent objectionable sway or vibration of the piping, and to prevent undue strains on the equipment served.

"Spring or counterweighted hangers shall be used wherever expansion and contraction of the piping or of the equipment to which it is attached, affects the elevation of either horizontal or vertical runs. These hangers shall be used wherever the change in elevation is not absorbed by the designed flexibility of the piping as a system.

"Springs shall be designed so that when tightly closed, the fiber stress will not exceed 60,000 lb per sq in."

The spacing of hangers and supports for steel and wrought iron pipe generally should not exceed the distances given in the following table:

Pipe Size, Inches	Maximum Spacing of Hangers and Supports, Feet
1 and smaller	6
1¼ to 2½, inclusive	10
3 and 4	14
6 and 8	18
10 and larger	22

As an appreciable amount of money is involved in providing suitable supports and anchors for these piping systems, it is advisable and worth while to carefully analyze each system before selecting hangers, anchors and vibration eliminators.

A brief resume of the purposes each of these items must serve is desirable in order to better understand the principles governing their selection.

Hangers

Hangers and supports, as a rule, offer the only solution to the problem of properly absorbing the deadweight of a piping system. If the line is not subject to any movement, it may be supported by means of rods from above or on brackets.

Where the system is subjected to expansion or displacement, the design of the hangers must be thoroughly analyzed. In such cases the hangers must be elastic and able to at least partially maintain their supporting action as the pipe elongates in a vertical plane. This is accomplished by the use of properly designed spring hangers.

In the case of a horizontal line subjected to a vertical displacement due to the action of some other part of the piping system, the hangers should allow up and down movement without unduly disturbing the distribution of the load. Where such a line is subjected also to lateral displacement and the headroom is too small to permit the use of long rods which would give the required swing, spring hangers should be used in which there are incorporated features which will permit free movement of the pipe in the horizontal direction.

Sway Braces (Vibration Eliminators)

Vibration eliminators should be installed where necessary to reduce to a minimum the vibration brought on by pressure surges and water hammer. These eliminators can be used also to great advantage at such points in a pipe line where it is desired to partially restrain the movement in some particular direction while at the same time permitting movement in other directions.

Anchors and Guides

Solid anchors are used at these points where it is desirable to hold the pipe rigidly in place. Such anchors serve to divide a pipe system into individual sections with respect to expensive movement. Each section should be capable of adequately absorbing the thermal elongation occurring between its respective anchored points.

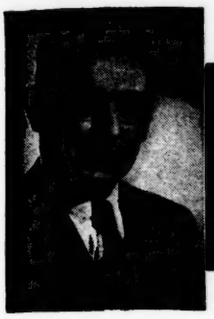
Sliding anchors or guides are installed where it is desired to guide the expansion movement.

Surplus Supplies Help Provide Heating System

A radiant heating system for an office building of the Marine Corps Air Station at Cherry Point, N. C., was fabricated almost entirely from surplus materials.

About 1,700 ft of 1-inch galvanized wrought iron pipe from the coils, and 200 ft of 2-inch pipe were used for headers because they were in excess stock available to Cherry Point Air Station. The pipe bending device was made in the Air Station machine shop, and the job of bending, fitting, and welding the pipe was done entirely by the personnel of the Marine Corps.

The heat exchanger was made from a surplus storage tank, by fabricating a flange nozzle of suitable size to receive a surplus copper coil heating element that was available, and incorporating the other necessary nozzle openings in this tank. The heat exchanger heats the water which is circulated through the radiant heating system by utilizing the available Air Station steam supply.



Experience is my Classroom

By T. W. REYNOLDS

• ODD USE OF STRUCTURAL SHAPES

Watching the show at a dinner of a contractor association, the writer gradually became aware of the conversation of two nearby old-timers in which they related odd tales about building construction. Mention was made of the Lally column, some of which were found serving the double purpose of columns and roof drains. Not so strange as this (as the writer can testify, since he has encountered the same thing) was an oversize column being used to provide a 4-in. hollow shell or center as a roof drain where there is an underfloor drainage system.

Sometimes electrical conduits have been run up through the center of these columns and upon occasion these columns are still cast with elaborate attachments to give the most bizarre and ornamental effects. No doubt they have been used as vents; in fact, only recently there was a party around trying to promote the idea of using the steel columns of buildings as duct risers for air conditioning.

All this brings up a train of thought and of apprentice days when the writer designed the heating for the Lally column factory in Brooklyn. They only wanted to keep the concrete cores of the columns from freezing while still wet, so the writer calculated to hold a safe 40F temperature, but got in around twice as many unit heaters as were ever used. Calculations went wrong because 40F leaves relatively little sensible heat to be extracted before latent heat comes into play. Before things could freeze, the latent heat from all moisture in concrete cores had to be given up, in addition to the sensible heat from the great mass of heavy pipe and concrete.

John Lally, the inventor of the portable concrete filled column, whose picture long graced the cover of the product catalog, passed on twenty years back in County Galway, Ireland, and there he was buried in the old family plot of the town where he was born in 1860. From 1883 to 1927 he worked in this country as hod carrier, plasterer, carpenter, brick and tile layer and then as a successful mason contractor on public buildings for 15 years.

His was the age of the telephone, telegraph and radio, when men shoved ahead without the benefit of laboratories and had to be creative, resourceful, ingenious and inventive. He invented, among other things, a perfected fireplace throat, waterproof cellar, masons' staging, angle trowel, plumbers' ball cock, and a plastering machine which actually put mortar on lath. He seemed to have invented everything short of flexible rigidity.

He even invented a double-headed nail which is, of course, a nail with two heads on one end and just far enough apart for the inserted claw of a hammer when extracting the nail from the wood forms of concrete. At the time of his death he was still fairly active, developing something of an aircraft nature.

Note: Mr. Reynolds is Chief, Air Conditioning Division, Abbott, Merkt & Co., Engineers, New York.

• "CROSS" VENTILATION

Whenever there are windows or other openings on two or more walls of a room, we say we have cross ventilation—ventilation across the room—hence, there is said to be not such a great need for air conditioning.

It is true that some offices on upper floors of skyscrapers do provide comfort by cross ventilation that can be bettered but little, if any, by air conditioning during the hottest months, but these same offices are less comfortable in the colder months with or without the open window.

Now, just how much air is moved by cross ventilation? When is it adequate and not too adequate? Does the air ventilate completely across the entire room or only part of the room? Does cross ventilation make occupants irritable by bringing in dust, by ruffling one's hair and papers and making cold drafts through a limited part of the area?

Cross ventilation is not always the same for different or even identical spaces, or for different hours of the day. It depends upon elevation, adjacent buildings and prevailing winds, while its effect, as to comfort, depends upon diffusion, the heat load of the space, and whether the roof (insulated or otherwise) is immediately overhead.

• ADDING ROWS TO COOLING COILS

Whenever a fan has excess capacity, more than can be properly handled by the system, there are several ways of overcoming the difficulty; or even turning the situation to advantage by adding rows to the cooling coils, although only slightly so in the last mentioned case. The capacity can obviously be reduced in various ways, such as by the use of variable inlet vanes or other forms of reduction control, or preferably by change to proper size of pulley. In any event, whatever method is chosen, it should first be definitely determined if there really is an excess in fan capacity, and, if so, just how much this is. Air flow readings (sometimes deceptive) and fan revolutions should therefore be checked by ammeter readings at the fan.

When the excess air produces unreasonable velocities or an air temperature too high for proper humidification and effective temperature within the conditioned area, adding depth to the cooling coils will not only reduce air volume to a slight extent, but together with the additional cooling surface may drop the air temperature to design requirements. Disadvantages are the added space requirements, more resistance for the fan motor to overcome, and the expense.

One may sometimes find a situation where the air quantity is not excessive but, due to a high ceiling or too high a temperature where actual heat loads are greater than computed, the air does not seem to circulate in sufficient quantity down to the occupied zone. Adding rows to the coil will, in such cases, permit the refrigeration of more outdoor air, thereby pressurizing the space to a greater extent to improve the air circulation at lower levels.

• RESISTANCE OF UNITS TO AIR FLOW

The question of resistance (internal, external, and total) of air conditioning units and unit ventilators arouses a bit of resistance within myself. It is a constant source of annoyance and, being frequently misinterpreted, often is responsible for unsatisfactory operation of a unit on the job. Manufacturers should agree on a uniform method of stating such resistances in their literature and engineers should do likewise in their specifications.

The situation which causes the greatest difficulty for the manufacturer's representative in determining what is wanted or necessary in the way of resistance, occurs when the engineer writes an open (or equal) specification instead of a flat specification. Seldom is the resistance which the unit must overcome clearly stated in the specifications. It may be so much cubic feet of air per minute against a *total* static pressure which includes external resistance and the loss through the filters and coils within the unit. In other cases there may be specified a given air volume per minute against a certain static pressure, in which case the manufacturer bidding on the job must guess whether this means total or external. If the resistance is given as total resistance for a certain unit, the competitive bidder must find out what internal static pressure was allowed for the competitive unit, and various units vary sharply in resistance.

The solution to the difficulty could be accomplished in several ways. One way would be to specify the internal resistance of the unit, the filter resistance, and the external resistance to be overcome by the quantity of air required. The external resistance would be that of the ducts, outdoor air louvers and the like. If the internal resistance is not given, at least the external resistance should be in an or equal specification. Even with a flat specification all resistances should be clearly stated, since many a flat specification does not remain so upon final selection of equipment.

Some manufacturers give the total resistance for their unit and from this the motor horsepower can readily be determined. The exact horsepower, however, is not necessary in advance of selection since no electrical engineer can figure wiring so closely. Other manufacturers state the internal resistance of their unit with or without the filters. Filter resistance may be given by some small note while others give it more prominence. Then, too, some owners change the filters to those of different resistance, or leave some filter sections out. Still other owners change the filters while still fairly clean, while others leave them practically filled with dirt. Here is where fan inlet control would be most desirable.

Some engineers save time by roughly assuming the resistance of their ducts, usually allowing too much. Others forget to allow for the internal resistance of the unit and end up with far too much total resistance. For example, a recent job had a fan that was noisy because the specifications called for $\frac{5}{8}$-in. external resistance and there wasn't that much in total resistance on the whole job. In any event, actual resistance of ducts when erected is not the same as computed from the plans.

The situation with unit heaters is somewhat similar. Necessary data are length of throw, outlet velocity, and decibel rating for quietness. Not all catalogs give all of this information, and, as a consequence, someone buys a heater because it is cheaper, only to find it does not complete the throw.

• ABSENTEE BURNER OWNERS

Many house owners set their thermostat for low temperature and then go South for a time, leaving the oil burner completely on its own. What happens then should the automatic water feeder (if any) fail to feed, or a high wind or a low burglar leaves open a window or door, so that the water pipes freeze, particularly so if the oil tank runs dry due to continuous firing. Under such conditions, with thermostat set down to 40 or 50F, any freeze-up will be much quicker. Better to make the setting at 60F, a better temperature in any event for keeping the house and furniture in good condition.

What happens, also, should a safety control for some reason or other shut down the burner. Upon rare occasions they do, usually when the house is occupied, but when reset often continue to function normally without disclosing the reason for the shut-down. For instance, the safety control on my own oil burner stopped the burner, fortunately just before I went away on a trip, but there was no reason why it should not have failed later rather than sooner.

No heat in a house (plumbing drained) is not a condition tending to preserve the house, but it is better than a house damaged by a smoky burner (still another liability). On the other hand, a house with adequate heat maintained, but with a daily check-up by a neighbor for burner failure is no doubt a reasonable gamble, considering that the few troubles known to have taken place are distributed over millions of homes.

Personally, for reasons of safety, the writer prefers to shut down his burner at the switch when leaving the house for only a few hours or a day. A house,

insulated or otherwise, cannot freeze up in a day, and the 50 or 60F resulting by the time one returns is soon raised to 70F, and is not too uncomfortable, meanwhile with heated air currents circulating and radiation making itself felt.

• DRYING OUT THE NEW STRUCTURE

When a furniture store owner has a lot of new furniture awaiting storage in his new warehouse soon to be completed, he most certainly would like to get it out of the way. Under such conditions, it becomes hard for him to understand why one cannot compute and give assurance that all will go well with the furniture in spite of the damp building. The trouble is that water may lie here and there on the floor where the roof is still open to the sky. On top of this, some of the floor may still have to be cemented over with a patent finish which must be covered with burlap and kept moist for a couple of weeks.

The writer is thinking of a particular building wherein a sling psychrometer in early December showed 74% RH with a 48F temperature, while outdoors it was 44% RH and 50F. A separately enclosed space not subject to furniture storage had 67% RH while a furniture space 40 ft in from a large open door had only 64% RH, or a drop of 10%, due to ventilation from the door.

Authorities say that relative humidities where furniture is kept should be as high as possible in the winter, though well below the point of condensation on walls (this would be in the neighborhood of 35% to 40% for dried out structures), but during the summer months the relative humidity should preferably be from 40% to 50%. Of course, a lot depends upon the grade of furniture. For example, veneer may soon come loose with high humidities, and the moving parts of high grade furniture put together with extremely close clearances will stick even in the usual basement storage space in old buildings.

The owner may argue that he carries higher humidities in his home during the summer months, yet without affecting the furniture. He little realizes that such humidities are not maintained long enough at a time for the moisture to permeate the furniture, and that he is talking of summer conditions when windows are open and there is an absence of the high dew-points of winter time. He may even suggest that many fans be installed to ventilate and dry out the space, say enough for two air changes per hour, not appreciating that such quantities of air would drop the maintained indoor temperature from 60F to about 30F with zero temperature outdoors.

At a temperature of 30F the air would pick up much less of moisture, only about 25% for the same quantity of air. On the other hand, since the present mechanical roof ventilators (in the particular building in mind) can exhaust only about one-half air change per hour, the proposed fans at two air changes would give eight time as much air removal, though at only 25% moisture pick-up. In other words, the net effect would be only twice the amount of the former moisture removal, and this at the expense of freezing the water pipes and the few workers, as well as the walls and the glue and moisture in the furniture. At such low temperatures, furniture is also subject to "white bloom" or change of color of varnish. When the outdoor temperatures are above zero, a certain amount of added ventilation could be obtained by opening the large outside doors. Unfortunately, these doors are all on one side, hence the diffusion would not be good, nor could the wind blow in one door and then back out against itself through some other door on the same side.

There are still other difficulties, since only one of the three boilers in the case in mind will be shortly on the line. Certain mains to other spaces could be valved off, so that all available heat could be concentrated on the furniture area in question. This would provide just enough boiler capacity, considering that steam is required to raise the cold structure to 60F and evaporate the moisture, in addition to maintaining the regular building heat losses at 60F with zero outdoors and only one-half air change per hour. On top of this, no boiler with a brick setting can be fired enough to provide heat while the setting is being dried out. A slow fire should be maintained for a week.

In the removal of moisture temperatures must be high enough for the air to pick up a reasonable amount of moisture and there must be enough ventilation to give good diffusion and remove the pick-up. Ventilation beyond this only adds to the cost of moving air and drops the temperatures to dew-points at which the ceiling may shed its moisture. Whether insulated or not, the ceiling will rain down its moisture once the dew-point is reached. It is difficult to make any real good estimates as to moisture removal. Moisture in the incoming air varies and, as the temperature outdoors rises, so will the temperature of the indoor air when uncontrolled; that is, providing temperatures above 60F or 70F are not objectionable while drying out.

One can do some figuring. For example, brick will absorb moisture up to 7% or 8% of its weight. As for concrete, this takes 5 to 7 gal of water to one bag of cement, or to one cubic foot of concrete. Of this water, 2½ gal are needed to hydrate the cement; in other words, this quantity of water mixes with the cement chemically and therefore need bother us no more. The difference between, say, an average of 6 gal and 2½ gal is the moisture that remains in the wall, not all of which can ever be removed. Let's say 75% can be removed.

Taking concrete at 150 lb per cu ft, the weight of water to be removed would be about 15%, or say only one-half of this, considering prior evaporation from initially super wet walls. On this basis, in the building in question, there would be 500 tons of moisture removal requiring (at not over 60F and 50% RH indoors) about two months to evaporate at the rate of 350 lb of moisture per hour. The horsepower to be added to the usual heating load of the space on account of raising the building to temperature and evaporating the moisture would then be approximately only 10%, although the writer has heard of new buildings where the fuel was two to three times the normal during the first heating season's operation. No doubt much of this is due to poor adjustment of the oil burner for the first few months of use.

Abstracts AND Reviews

Publications abstracted in this department should be ordered direct from publisher.

HEAT INSULATION

Engineers, architects, students and others concerned with insulation, will find much of value in Heat Insulation by Gordon B. Wilkes, professor of heat engineering, Massachusetts Institute of Technology, Cambridge, Mass.

Ever since 1910, Prof. Wilkes has been closely associated with insulation problems and he has developed equipment to determine the effectiveness of heat insulation over a wide range of temperature. The author has spent over 35 years in laboratory work determining heat transfer data. He has spent many years in experimental work with reflective insulation and emissivity determinations.

Information is given on the types of test equipment used to determine the effectiveness of heat insulation. The book includes a detailed discussion of the various factors affecting the *K* value and tables of conductivity values, specific heat data for insulation, and emissivity figures.

The text is divided into the following nine chapters: Purposes of heat insulation; fundamental formulas; methods of determining heat transfer coefficients; factors affecting the coefficient of thermal conductivity; types of insulating material; reflective insulation; specific heat of insulating materials; moisture in insulation; economies of insulation. In addition there are 43 pages of important tables arranged as an appendix.

Heat Insulation, by G. B. Wilkes. Cloth bound, 5½ x 8¼ inches, 224 pages. Published by John Wiley & Sons, Inc., 440 4th Ave., New York 16, N. Y. Price, $4.

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CONTROL OF ODORS—Information on the control of undesirable industrial and household odors is presented in National Bureau of Standards Circular 491. Use of masking, anesthetic and irritant effects are explained. Government Printing Office, Washington 25, D. C. Price, 10 cents.

INSTRUMENTATION FLOW PLAN SYMBOLS—The Instrument Society of America has published the ISA Tentative Recommended Practice RP5.1 on Instrumentation Flow Plan Symbols. The objective for this report is to provide uniformity in the field of instrumentation as regards symbols and identification markings. The system presented is intended to designate and identify instrumentation on flow plans and for recording on specifications in order sheets. Instrument Society of America, 921 Ridge Ave., Pittsburgh 12,, Pa. Price, $1.

WARM AIR HEATING LIBRARY—All of the publications of the National Warm Air Heating and Air Conditioning Association are now available in one volume known as the Warm Air Heating Library. It contains the association's manuals No. 1 through 9, copies of the work sheets and samples of the promotional material prepared by the association. It also has articles on various phases of warm air heating problems and applications. The manuals included are: How to Make a Comfort Survey; How to Check Frame House Construction; How to Figure Heat Losses; Perimeter Heating Systems; Code and Manual for Gravity Systems; Service Manual for Continuous Air Circulation Technicians; Code and Manual for Winter Air Conditioning Systems; Code and Manual for Ceiling Panel Systems; A Yardstick for Classifying Warm Air Winter Air Conditioning Systems; and Code and Manual for Design and Installation of Large Warm Air Winter Air Conditioning Systems. National Warm Air Heating and Air Conditioning Association, 145 Public Square, Cleveland 14, Ohio. Price, $8.

REFRIGERATION NOMENCLATURE FOR TEXT AND DRAWINGS—The American Society of Refrigerating Engineers has issued, in pamphlet form, the proposed American Standards covering refrigeration nomenclature for text and drawings. Material is divided into two parts—Part A covering graphical symbols and Part B, abbreviations. American Society of Refrigerating Engineers, 40 W. 40th Street, New York 18, N. Y. Price, 40 cents.

REFRIGERANT TABLES AND CHARTS—A 93-page booklet, which is information reprinted from the ASRE Data Book issued in 1949, covers refrigerant tables, charts and characteristics. It contains, in one booklet, tables of properties, pressure-enthalpy diagrams, and Mollier charts for commonly used refrigerants. The forms of the tables have been rearranged and improved and the tabular material critically re-examined and brought up to date. American Society of Refrigerating Engineers, 40 West 40th St., New York, N. Y. Price, paper bound, $1.50; cloth bound, $2.00.

INUNDATED ANTHRACITE RESERVES—Part of a broad survey of the flood-water problem in the Pennsylvania anthracite region is available as Bureau of Mines Bulletin 491 on Inundated Anthracite Reserves, Eastern Middle Field of Pennsylvania. Anthracite reserves in this part of the state are approaching exhaustion and underground water pools make some of the remaining coal mines unminable. Although there are 32 known water pools in the eastern middle field, the report notes that reserves inundated by 15 of them are insufficient to make draining worthwhile. Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price, 15 cents.

NEWS OF EQUIPMENT AND MATERIALS

Use the prepaid postcard opposite Page 106 for securing additional information on items described in this department.

Cooling Towers for Small Jobs

A new series of induced draft cooling towers for use with self-contained refrigeration and air conditioning equipment, is announced by Acme Industries, Inc., Jackson, Mich. All unnecessary parts have been eliminated to reduce weight to the minimum consistent with long life. They may be used for indoor or outdoor application with external duct resistance of ¼ inch or less. These models are designated as Models TCJ-2, 2A, 3 and 3A.

These are for use with units up to and including 5 hp and are designed to save water and fill a need for low-cost, efficient cooling towers in this range. Fans are located at the top to provide vertical movement across the filling. Air is discharged horizontally at a velocity sufficient to prevent recirculation. The air intake and louver assembly is fabricated into a single assembly and is designed to eliminate splashing.

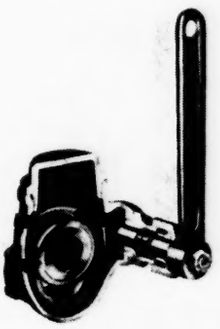
Towers are not furnished with pumps because so many of these towers are being applied to existing systems, each requiring individual pump selection. However, connections are provided to permit the use of an attached pump.

For more information, circle on Inquiry Card, **Item 1**

Fast Action Gate Valve

A rapid-action, bronze lever gate valve with features that assure maximum tightness and longer life is introduced by Jenkins Brothers, New York 17, N. Y.

The valve, called the Swing-tite, has ball and socket design double discs which adjust readily to seat surfaces. Guide rims *A* on these discs rotate freely on the guide tracks *B* cast in the body, as the valve opens or closes. This roller action provides a self-cleaning and polishing effect, and also distributes the wear, since the seating position of the discs changes with each closing. This rolling disc and track construction assures accurate seating with continual tight closure, and prevents uneven wear of the discs.



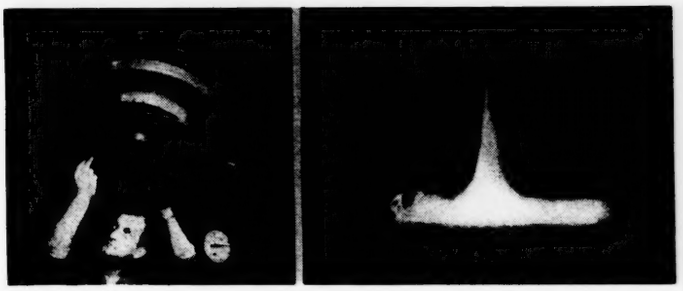
With a liberal dimensioned body and cap, manganese bronze spindle, and deep packing box, the valve will withstand rough usage and contain pressures beyond those for which it is rated. The malleable iron lever can be placed in four different positions with relation to spindle to suit installations.

The valve is rated for 125 lb steam service, 300 lb cold oil, water, and gas, and is made in ½-inch to 2-inch sizes.

For more information, circle on Inquiry Card, **Item 2**

Diffusers for Unit Heaters

Diffusers for its line of unit heaters have been introduced by The Trane Co., La Crosse, Wis., in two types.



The Louver Cone diffuser fits the company's projection type unit heaters, while the Louver Fin diffuser fits the horizontal type heaters.

The Louver Cone is shown in the upper view, left, where the technician is adjusting the blades to a 45 deg angle. At the right, the air is being directed straight down from a Louver Cone. This diffuser has 24 adjustable blades fitting between a die-cast hub and a cone-shaped spun steel rim. The blades may be adjusted with the fingers to direct the air from the unit heater in any desired pattern.

The Louver Fin diffuser for horizontal heaters, lower view, generally has seven horizontal and 56 vertical blades, each adjustable by fingers without tools. View at left shows the blades being adjusted to the right on one side, to the left on the other; the view to the right shows the result.

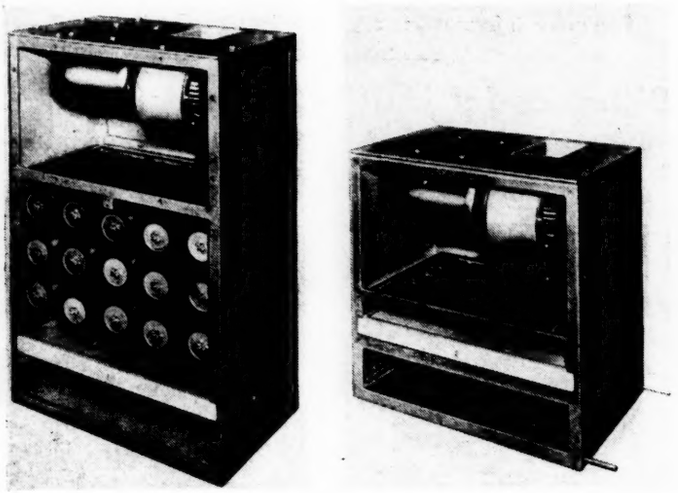
The company claims that development of the new diffusers greatly simplifies the problems of determining the exact location, size and combination of types of unit heaters for any given floor area. Because the diffusers can concentrate the flow of heated air in a column as much as 60% longer than the normal spiral cone, they permit use of smaller unit heaters to accomplish a given task. The ability to split the output of heated air two ways often eliminates an extra unit.

For more information, circle on Inquiry Card, **Item 3**

Crane Cab Conditioners

To fill the need for equipment that ventilates, heats and provides dust and fume protection for operators of crane cabs, Dravo Corp., Pittsburgh, Pa., has developed two new types of crane cab conditioners.

Model VHDF (left of illustration) is designed to provide continuous ventilation, heating, dust filtering,



and fume protection for crane cabs and small confined spaces in industrial plants. Model VHD (right of illustration) performs the same functions except for fume removal. This model is intended for use where noxious fumes are not a problem but where dust filtering, ventilation or heating may be required.

Fan sections of both units can be rotated 90 deg, enabling continuous discharge of fresh air from the tops or either side. They can be installed on the crane cab in a horizontal, vertical or an inverted position.

For cold weather operations, fresh air brought into the units is heated by electric strip heaters maintaining automatically controlled temperatures of between 68 and 72F in the crane cab.

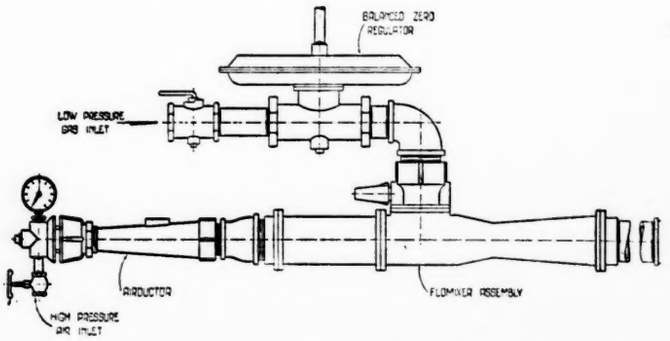
Either unit will operate on a-c or d-c power. Model VHDF is 16 inches deep, 26 inches wide and 42 inches high. Model VHD is the same depth and width but is only 26 inches high. Descriptive literature available.

For more information, circle on Inquiry Card, **Item 4**

Low Pressure Combustion Air

The Bryant Air-Ductor, a device for producing large volumes of low pressure combustion air (up to 1 lb) using high pressure compressed air as a power source, is being marketed by Bryant Industrial Division, Affiliated Gas Equipment, Inc., Cleveland, Ohio. There are many applications where a supply of compressed air, at 30 to 150 lb pressure, is available to induce atmospheric air and to produce a greatly increased quantity of low pressure air. This device is recommended by the manufacturer for use in installations where the low pressure air usage is infrequent and purchase of a blower would not be justified.

The makers claim the unit is easily installed and simple to operate. High pressure air consumption will average 25 to 35% of the volume of 16 oz pressure air produced. This will decrease with lower delivery pressures and higher compressed air pressures.

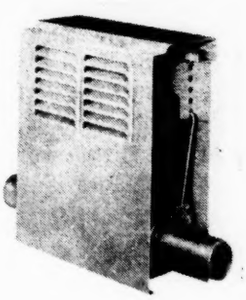


Unit is supplied with outlet connection sized correctly to minimize pressure losses. The assembly includes high pressure needle valves and pressure gages. Data Sheet 5 D-4 is available.

For more information, circle on Inquiry Card, **Item 5**

Baseboard Has High Output

The High Output baseboard convector, introduced by Kritzer Radiant Coils, Inc., Ill., is designed for locations where greater heat output is desired than that given by standard baseboard units. Taller than regular radiant baseboards, this baseboard achieves a high rate of convection.



Collared steel fins mechanically bonded on a steam pipe constitute the heating coil. The coil is hung on a bracket attached to a back-plate, while a louvered front plate is snapped into place, enclosing the coil from the front. Provision is made for easy adjustment on the pitch of the coil, to allow gravity return of steam condensate to the boiler.

Made in standard lengths up to 10 ft, with 1-, 1¼-, or 2-inch steel pipe, and 1- or 1¼-inch copper pipe, the baseboard can be ordered to fit any field condition.

For more information, circle on Inquiry Card, **Item 6**

Timer Shifts Load in Dual Job

The Type DU duplex cycle timer which can be employed to alternate automatically the operation of two motors, such as in dual pumping installation, is announced by The R. W. Cramer Co., Centerbrook, Conn. The timer will open and close one- or two-load or control circuits either continuously or permit the timer to perform one complete cycle and then stop.

Two styles are available—one for intermittent duty and the other with gears actuated by an electro-magnet, for continuous service. Bulletin 2000C available.

For more information, circle on Inquiry Card, **Item 7**

Attachment for 180° Bends

A radiant heat attachment for its 2-, 3- and 4-inch pipe benders for making 180° bends has been developed by Tal Bender, Inc., Milwaukee, Wis. The many parts of which the attachment previously consisted, and the different manipulations which were previously necessary, have all been eliminated by this new device.

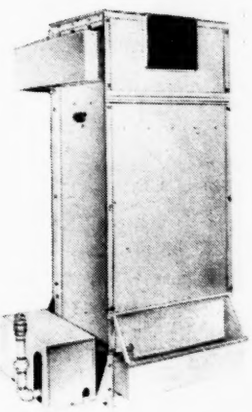
The two wings necessary for making the 180° bends are now each one single unit, without any loose parts, as shown in the photo. A different frame makes it possible to put the pipe in the bender, as shown above on the 2-inch bender in the front, and without any resetting of the wings, to make in one single performance 180° bends, as shown on the 3-inch bender (top unit).

This attachment is available with any desired standard center bending former, and is said to more than double the production in comparison to the previous device. If used with motor attachment, bends can be made in rapid succession.

For more information, circle on Inquiry Card, **Item 8**

Non-Corroding Cooling Towers

Two new evaporative water coolers, TE-10 and TE-15, are now being produced with corrosion-proof features by Servel, Inc., Evansville, Ind.



The body and packing of Models TE-10 and TE-15 (latter illustrated) are of asbestos cement sheets, which cannot corrode. All parts used for assembly and operation are made of non-rusting alloys. Blower and frame are protected by heavy hot-dipped galvanizing. The towers are equipped with flue-gas water treatment kits. These kits successfully eliminate the scale-forming or liming properties of hard water.

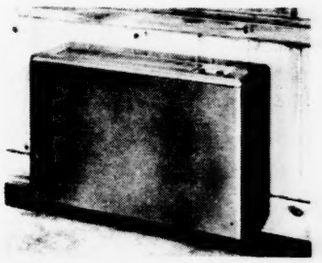
Model TE-15 evaporates a maximum of 15 gallons of water per hour, and is capable of cooling over 1,000 gallons (by a drop in temperature of 17 deg) per hour. Model TE-10 evaporates a maximum of 10 gallons of water per hour, and is capable of cooling 650 gallons per hour.

These water coolers are designed for use with the company's All-Year Air Conditioner and its self-contained air conditioner. They may be installed either indoors or outdoors.

For more information, circle on Inquiry Card, **Item 9**

Central System Room Units

Two new one-room air conditioners, known as the RVY Series, to be attached to a central system, have been announced by Worthington Pump and Machinery Corp., Holyoke, Mass. Designed to condition rooms in hotels, hospitals and offices, the units are suitable for buildings in which each room must be individually controlled by the occupant.



The capacity of the "300" unit is from 200 to 350 cfm; the "500" unit, from 350 to 600 cfm. Each unit contains one small 60-cycle, single phase motor which will operate on 115 volts. Conditioners may be furnished for direct expansion, where there are only a few units involved, or for chilled water for large installations.

The chilled water cooling coils may be converted by a single switch to become heating coils. Direct outside air may be taken through a filter or high pressure fresh air may be supplied. The units may be fully automatic, or manually controlled.

The conditioners consist of the finned cooling and heating coils, a drip pan, a standard casing which may be omitted for concealed installations, two double width double inlet fans, fan motor, filter and insulation. Panels are easily removed, and controls are in full view of occupant. Units are equipped with quiet operating, double width, slow speed, oversized fans.

For more information, circle on Inquiry Card, **Item 10**

Wall Furnace in 2 Sizes

Mid-Jet, a wall type gas-burning heating unit, is being made by Royal Heaters, Inc., Alhambra, Calif.

Unit has non-vision registers, curved similar to venetian blinds to completely hide the heating element, and a patented porcelain burner to give economical complete combustion and years of rust-proof, trouble-free service.

Its elevated case, 3 inches or more above the floor, allows free flow of baseboard. Case is made in one piece with round corners.

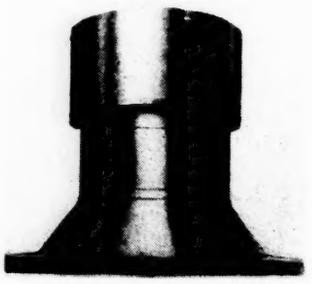
The compact airplane type heat exchanger achieves maximum circulation, eliminates hot spots, assures even distribution, and circulates clean warm air to all parts of the room. Flue temperatures are low.

The entire case is easily installed or removed for servicing. Unit is entirely assembled at the factory. Heater and case can be installed before or after plastering and painting, and fits between standard 16-inch-on-center studs.

For more information, circle on Inquiry Card, **Item 11**

Roof Ventilator for Industry

DeBothezat Fans Division of American Machine and Metals, Inc., East Moline, Ill., is now producing motor driven vertical discharge roof ventilators for industrial applications. The ventilators are designed for exhausting air from foundries, machine shops and other buildings where harmful exhaust fumes must be discharged high above the roof.

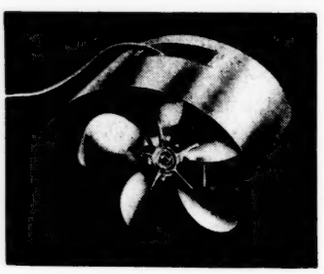


Ventilators are available with fan wheels 36, 42 and 48 inches in diameter and air capacities up to 40,900 cfm. The units are weather-proof at all times and are provided with wind guards. Damper blades prevent loss of heat when fan is not operating.

For more information, circle on Inquiry Card, **Item 12**

Low Cost Furnace Booster Fan

A booster fan for insertion in the cold air return of gravity warm air systems to convert them to forced air is being marketed by McLarty Systems, Battle Creek, Mich. One fan is installed in each cold air return. It is said to be the lowest cost fan for conversion from gravity to forced air on the market.



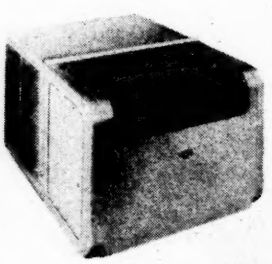
The fan fits in any round duct 12 to 18 inches in diameter. Fan runs at 800 rpm, has a capacity of 400 cfm, and draws 35 watts. The motor can be plugged into 110 volt a-c outlet. Both casing and fan blade are aluminum and the device weighs 5 lb packed.

For more information, circle on Inquiry Card, **Item 13**

½ Ton Room Air Conditioner

A streamlined plug-in ½ hp room air conditioner that fits almost any window is announced by Frigidaire Division, General Motors Corporation, Dayton, Ohio.

The unit is attractively styled with a rolled front and finished in gray enamel to blend with most decorative schemes. Compactly built, the cabinet projects only 13 inches into the room. It is 22½ inches wide, 30⅛ inches deep and 16¼ inches high, and will fit into any conventional double-hung window from 23 to 56 inches wide.



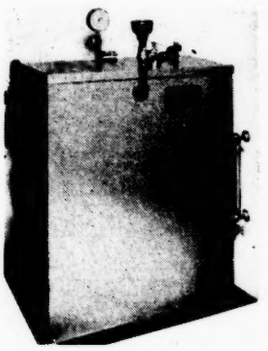
The compressor is hooked up to an aluminum finned copper tubing condenser and a three-row finned cooling unit. A plastic grille in the cabinet with adjustable louvers directs air up or down, and steel vanes on the chassis controls the flow of air right or left as desired. The unit circulates 220 cfm and can introduce outside air at 40 cfm.

A disposable filter can be easily removed for inspection or replacement through the bottom front of the cabinet. A steel mounting plate permits fast installation.

For more information, circle on Inquiry Card, **Item 14**

Electric Steam Boiler

A line of electric steam boilers has been announced by Livingstone Engineering Co., Worcester, Mass. This Model 400 boiler has a maximum working pressure of 50 lb per sq in. and is available in standard sizes from 3 to 25 boiler horsepower.



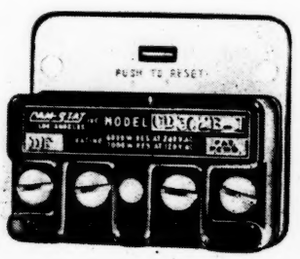
Boiler can be operated on 220, 440, or 550 volts, single or polyphase.

This boiler is designed to meet the demand created by the rapidly increasing number of states and municipalities which are passing laws and ordinances requiring that all steam boilers, even for pressures below 15 lb, be built to ASME Code specifications and carry the National Board of Boiler and Pressure Vessel Inspectors' stamping. It is intended for process heating of plastic presses, jacketed kettles, sterilizers, autoclaves, degreasers, and other steam-using equipment.

For more information, circle on Inquiry Card, **Item 15**

Overheat Control Switch

A manual reset overheat control switch, which provides positive protection against temperatures in excess of those for which the equipment is set, has been developed by Cam-Stat, Inc., Los Angeles, Calif.



Features of unit are: Cut-out temperature at any level from 160 to 200 F in steps of 5 F; rating of 6,000 watts resistance load at 240 VAC; large, silver contacts; hammer action-clean break operation; double-pole, single-throw switching action.

The unit can be supplied integrally mounted to the single-pole, double-throw water heater thermostat so that no extra installation costs are involved. It can also be supplied as a separate control switch for equipment which is already in service.

For more information, circle on Inquiry Card, **Item 16**

Automatic Hot Water Air Valve

The Ventmaster valve for automatically eliminating air from hot water heating systems has been announced by The Keeney Mfg. Co., Newington, Conn. It is designed for pressures up to 30 lb per sq in., is easy to install, is completely automatic and can be manually operated for fast venting and re-set at any time. The all-brass body is finished in polished chromium plate. Internal construction consists of a silicone variable orifice and a series of hygroscopic discs, designed for maximum life of the valve. Manual venting, necessary only upon initial installation, is achieved by backing off the top retaining cap with a screwdriver. Valve is returned to fully automatic operation by screwing the cap up tight. Cap cannot be removed. This unique safety feature eliminates the hazard of losing control of the valve during manual venting.

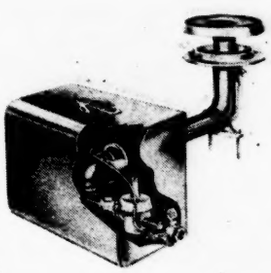
In the photo, *A* shows the venting plug with slot and vent holes, *B* the rolled edge safety feature which prevents plug from popping out under pressure, *C* is the venting plug, *D* the hygroscopic venting discs, and *E* the silicon filter.

For more information, circle on Inquiry Card, **Item 17**

Chrome Plates on Gas Burner

A gas conversion burner, the Gasaver, is announced by The Williamson Heater Co., Cincinnati 2, Ohio. The burner, listed by AGA, has a capacity of from 100,000 to 350,000 Btu per hr input.

Need for a high-low flame is eliminated, since direct radiation from flame to furnace or boiler is effected, and there are no refractories. Chrome alloy cast iron lower and upper deflector plates with streamline contouring assure maximum use of gas delivered. Bulletin WAR-2 is available.

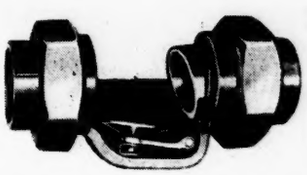


For more information, circle on Inquiry Card, **Item 18**

Combined Check and Unions

A double union swing check valve with full opening for use in lines where no stop is installed close to the check valve and where pipe cleaning mechanisms (co-devils) are used, has been introduced by Catawissa Valve and Fittings Co., Catawissa, Pa.

These valves, designated as Series 502 check valves, can be used in either horizontal or vertical position, are furnished with union connections on both ends, insuring a perfect seal and eliminating the use of a full union and nipple necessary to install the regular type check valves. This feature also permits the line to be broken at the inlet end of the valve while the check holds the contents of the line. By braking both union connections, body may be removed for repair or replacement.



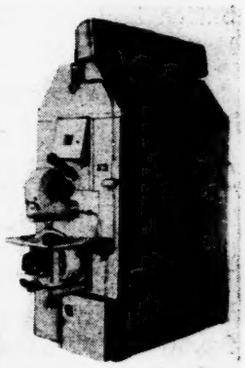
The check valves are available in 2-, 2½-, 3-, and 4-inch sizes in either black and orange or cadmium finish and with standard coupling nuts or lug nuts.

For more information, circle on Inquiry Card, **Item 19**

All-Fuel Direct-Fired Heaters

The Series 50 industrial type warm air heaters, for industrial and commercial buildings, process work, and make-up air applications, is introduced by Arthur A. Olson & Co., Canfield, Ohio.

Improvements have been made on control panel, induced draft fan and external design. The restyling makes an attractive floor or suspended unit.



Large areas of heat transfer surfaces with long four-pass gas travel results in low stack temperatures and high efficiency. Bearings mounted on the outside of the heater provide easy maintenance and accessibility. Separate induced draft fan assures warm air at all times.

The package type units, designed for oil, gas or L. P. gas, are built in capacities from 300,000 to 2,000,000 Btu per hr. The stoker heater is built in capacities from 500,000 to 2,000,000 Btu per hr and the large central type heaters are built in capacities from 2,500,000 to 6,000,000 Btu per hr. They can be used with stoker, heavy oil, gas, or any other type of fuel. Full information is presented in Bulletin 30-B-1.

For more information, circle on Inquiry Card, **Item 20**

Packless Sealflo Liquid Indicator

The packless principle is used in the Sealflo liquid indicator, made by Fine Products Co., Chicago, Ill.

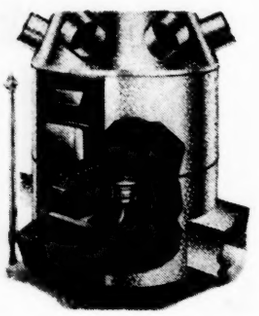
The Pyrex gage glass is fused to a special alloy metal diaphragm which in turn is sealed to the brass viewing tube. This resilient diaphragm permits the glass to float between the sealed expansion chambers so that the glass gage is left free to contract or expand.

Unit has two large viewing ports to secure a quick accurate check on the amount of liquid.

For more information, circle on Inquiry Card, **Item 21**

Burner with Modulated Flame

The 1951 line of its gas conversion burners has been introduced by A. O. Smith Corp., Milwaukee, Wis. Burners are available in two models, the deluxe Model 205 (illustrated), with modulating flame control, and the standard Model 201.



The modulating burner on the deluxe model automatically varies the flow of gas in accordance with demand. The control valve is installed in the gas line ahead of the gas valve and is actuated by the temperature of the cold air duct or return water temperatures in the case of forced hot water.

The standard model has a single port burner, push button ignition, accessible controls and stainless steel heat distributor.

For more information, circle on Inquiry Card, **Item 22**

Single Unit Utility Blower

A single inlet blower for low pressure uses, Model 8½-12, is being made by Schwitzer-Cummins Co., Ventilating Division, Indianapolis, Ind. Housing members are press formed from sheet steel, welded into a solid unit. The wheel is 8½ inches in diameter and 3¼ inches wide. Blades are press formed and double riveted into heavy end rings. Unit has a rectangular exhaust opening.

Blower is driven by a 1/12 hp, 115-volt capacitor type motor. Overall height is 15¼ inches; width 13¼ inches. At a ⅛ inch static pressure, delivery is 360 cfm; at ½ inch SP, 250 cfm.

For more information, circle on Inquiry Card, **Item 23**

Gas Furnaces in Three Types

A new line of gas furnaces has been placed on the market by Combustioneer Division, The Steel Products Engineering Co., Springfield, Ohio. The units consist of gravity, forced air and hi-boy models with an input range from 85,000 through 150,000 Btu per hr. All units have been tested and approved by AGA for natural, manufactured, mixed and L. P. gases.

The furnaces feature a 12 gage steel heat exchanger. Cabinets are made of 20 gage steel and have die-rounded corners and slip-joint assembly. Also incorporated in all models is a clean-out opening in the lower front section of the radiator. Forced air models have dual blower access doors on both sides of cabinet. Blower units are suspension mounted.

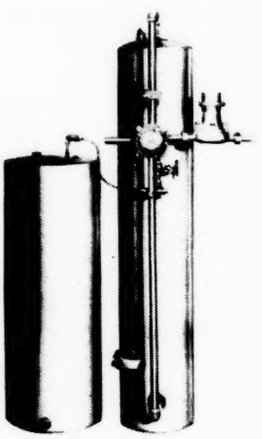
Furnaces are equipped with an impinged type, multi-jet gas burner. Standard equipment includes stainless steel humidifier, horizontal draft and diverter and optional controls.

For more information, circle on Inquiry Card, **Item 24**

Zeolite Water Softener

A small zeolite water softener for apartment houses, hospitals, and uses where the requirements may be under 100 gpm is being made by Cochrane Corp., Pa.

Designed for low initial cost, simplicity of operation and for low cost of chemicals used, the Junior Industrial Zeolite Softener is supplied in two groups and in single and double units, to meet practically all requirements. Group I comes in 12-, 18-, 24-, and 30-inch tank diameters; Group II in 36-, 42-, and 48-inch diameters.



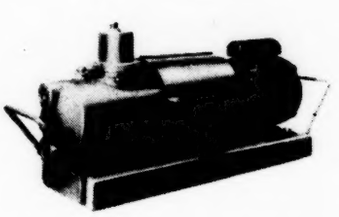
The single unit is recommended if a storage tank for softened water is available which can be called upon while the softener is being backwashed and regenerated (about 45 minutes). A single unit may also be used if the supply of softened water can be interrupted during backwash and regeneration, or if raw water may be used temporarily during this period.

If this is not possible, and a continuous supply of softened water is mandatory, the double unit softener is recommended.

For more information, circle on Inquiry Card, **Item 25**

Vacuum Pump for Test Work

The Beach-Russ Co., situated in New York, N. Y., is making a new Model A two-stage vacuum pump for dehydrating and testing refrigeration and air conditioning units, lighter and more compact than the old unit it replaces. The new pump blanks off at 1/10 mm or 100 microns. It weighs only 80 lb, and has an overall length of 28 inches. The pump is driven by a 1/3 hp motor with any desired current characteristics. Pump lubrication is automatic.

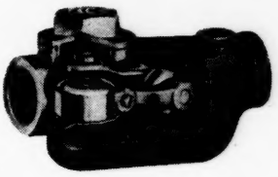


Its ready portability, lightness and ability to handle water vapor at a relatively high vacuum makes it suitable, it is claimed, for laboratory, pilot plant and field test jobs.

For more information, circle on Inquiry Card, **Item 26**

Horizontal Flow Checks

Horizontal flow checks, in sizes of 1, 1¼, 1½, 2, 2¼ and 3-inch, are being made by Taco Heaters, Inc., Providence, R. I., for domestic hot water systems. It prevents the hot boiler water from flowing to the heating system, when the circulator is not running, so that the boiler can be used for generating hot water summer and winter.



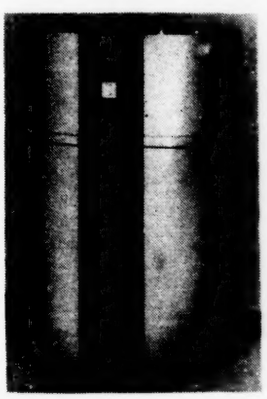
The check has a bronze spring cushion, bronze working parts, and visible three-position adjustment, such as open, closed and normal. The seat can be cleaned by moving the adjusting lever up and down while the circulator is running.

For more information, circle on Inquiry Card, **Item 27**

Boiler-Burners for Oil or Gas

Boiler burner units for oil or gas firing have been added to its line by York-Shipley, Inc., York, Pa.

Available in three sizes for steam or hot water heating, the PBOE Model features an interchangeable burner mounting to which can be applied a York-Heat oil burner or gas conversion burner. Improvement on this line, which has an oval extended jacket covering the burner and controls section, is redesign of the jacket on the right side so that the controls and burner section are more easily accessible for adjustment service. Units have a built-in Hartford loop for faster installation and a large tankless water heating coil.

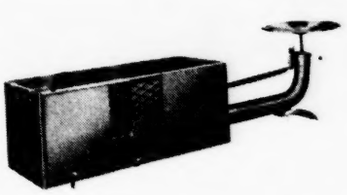


The boilers are available for 300, 400, and 550 sq ft of steam radiation and equivalent for hot water.

For more information, circle on Inquiry Card, **Item 28**

Large Capacity Gas Burner

A large capacity gas conversion burner which permits quick and easy conversion of industrial and commercial heating plants is now being manufactured by Norman Products Co., Columbus, Ohio. It is particularly adaptable for converting apartment house and commercial heating plants, process steam uses, and many other types of large heating systems. It is available in three models: 500,000, 750,000 and 1,000,000 Btu input per hour, for use with natural, mixed and manufactured gas.

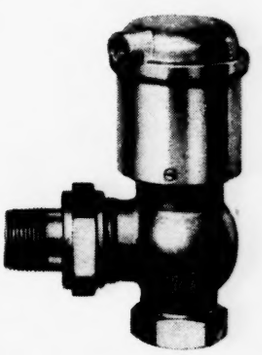


Each burner is factory-tested before shipment and comes completely assembled in one package. It can be quickly installed with a minimum of time and labor. All models feature the single-part, self-piloting flame-retention principle. The telescopic burner tube permits easy adjustment for burying depth. It is equipped with adjustable front and rear leveling legs, and cast chromium distributor plate. Controls are of the latest AGA listed type and are completely housed beneath the easily removable end cover.

For more information, circle on Inquiry Card, **Item 29**

Piston Valves for Convectors

A new line of control valves with piston operators, for convector and other applications in confined spaces where ordinary control valves cannot be accommodated, has been developed by Johnson Service Co., Milwaukee, Wis.



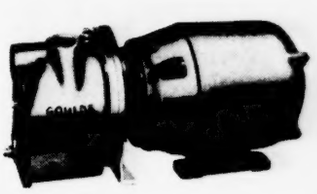
Because of their extremely small size, and the availability of various body patterns, these valves are adaptable to almost any type of piping connection for accurate proportional control of low pressure steam, or hot or cold water. They are made in ½ and ¾ inch pipe sizes.

In the water valves, a V-ring self-sealing packing utilizes the force of the water pressure to effect a positive seal. No adjustment for static head or wear is required. For low pressure steam service, special molded split-ring packings are used for long life. Bulletin V-160 is available.

For more information, circle on Inquiry Card, **Item 30**

Self-Priming Pump, ¼ to 5 HP

A new line of self-priming centrifugal pumps has been announced by Goulds Pumps, Inc., Seneca Falls, N. Y. Valves are eliminated by the design of these pumps. Pump is positive self-priming, eliminates need for large and bulky priming reservoir, and recirculation of water during pumping stage. Pump efficiencies are said to be comparable to standard centrifugal pumps.

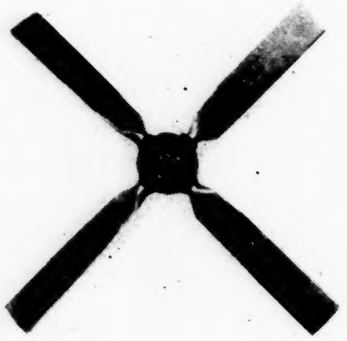


It is made in sizes from ¼ to 5 hp, open and closed impellers; capacities to 120 gpm and heads to 135 ft, depending on capacity; suction lifts up to 25 ft. Full data are published in Bulletin 636.1.

For more information, circle on Inquiry Card, **Item 31**

Large Axial Fan for Industry

Development of a high efficiency Aeromaster industrial axial fan employing aerodynamic design principles and aircraft production techniques has been announced by Koppers Company, Inc., Pittsburgh, Pa. It is applicable to large air conditioning systems.



Fans are being manufactured in sizes ranging from 6 ft to 20 ft diameter. The 20 ft dia fan is capable of delivering 500,000 cfm and is designed for continuous, open air operation.

Blades are designed according to standard aircraft airfoil procedure to produce aerodynamically efficient blade sections. The blade profile is modified from the aircraft shape to better adapt the blade to move a large volume of air at a minimum of horsepower rather than the development of high thrust. Fan blade core is made of laminated birch, bonded with Koppers Penacolite resins.

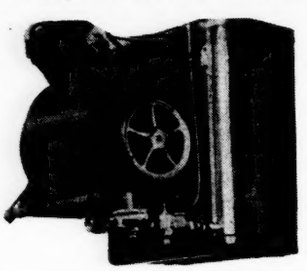
During assembly, opposite blades are matched and each fan unit is pre-balanced in a draft-proof room to insure perfect balance. Pitch angle of blades may be changed.

For more information, circle on Inquiry Card, **Item 32**

Blower Type Gas Unit Heater

A blower-type gas-fired unit heater is added to the current line of the Reznor Mfg. Co., Mercer, Pa.

Produced in eight different sizes, the blower heaters (US-B, unit suspended, blower) are practically the same as the company's fan type suspended heaters except that the propeller is replaced by a powerful, centrifugal type blower. A belt drive is used on larger size heaters; direct drive with variable speed control is used on 50,000 and 25,000 Btu sizes. Other sizes are controlled by a variable sleeve pulley.



Heaters are equipped with summer and winter switches, are soundproofed and cushioned in rubber and felt to deaden vibration. Blower is mounted on rubber cushions, and an air seal is placed between the blower and heater. Capacities range from 25,000 to 200,000 Btu per hr input.

For more information, circle on Inquiry Card, **Item 33**

Boiler Feed Water Treatment

Boiler feed water can be treated by the Hot-Z system developed by the Water Treating Division, Worthington Pump and Machinery Corp., Dunnellen, N. J., which combines the advantages of both the hot process and the zeolite process.

A styrene base resinous zeolite suitable for operation on hot treated water makes it possible to combine hot process treatment with its deaerating and silica reduction features with zeolite softening which assures uniform hardness reduction to 0.2 ppm without addition of excess sodium alkalinity. Temporary hardness is removed by the lime and zeolite treatment while the zeolite removes the permanent hardness. Regenerant for the more expensive soda ash customarily employed for removal of permanent hardness in hot process softeners.

The zeolite must be backwashed with clear water and at less frequent intervals regenerated with salt solution. Since uniform temperature provides the best environment for the zeolite, means are provided for maintaining the backwash water and regenerant at the same temperature as the water under treatment.

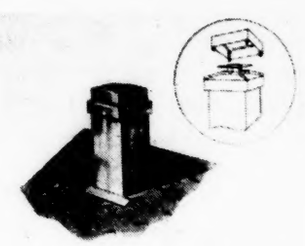
An annular wash water compartment, separate from the treating chamber, is provided in the hot softener tank. Thus a proper volume of hot water is always available for backwashing by back-flow through the zeolite or filter, if any. Sedimentation reclarifies the water within two hours. The salt regenerant is brought up to temperature by means of a steam heater.

For more information, circle on Inquiry Card, **Item 34**

Rain Cap for Metal Chimney

A new rain cap and shield for the prebuilt, all-metal Thulman chimney used in one- and two-story homes is being made by The Majestic Co., Huntington, Ind.

Readily attached to the ornamental, ventilating chimney top, this metal cap is said to prevent water from entering the flue even during hard downpours.



Topside louvers along each edge of the metal fitting allow smoke to escape unhindered from the vitreous enamel-coated, steel inner flue. Air currents can circulate freely between the two concentrically placed aluminum ducts that jacket the flue. The chimney is self-cooling, non-condensing, and reported to be safe for use with any fuel.

The chimney is made in lightweight sections for easy assembly and installation by one man. No footing is needed for the assembled unit hangs on joists for time-saving, low-cost installation.

Hot flue gases rising when the furnace is in operation induce a draft of cool air between the two casings that surround the flue proper. In a matter of seconds, the chimney is producing maximum available draft. When heat is shut off, it reduces "standby" losses by quickly cooling and slowing the flow of cool air.

For more information, circle on Inquiry Card, **Item 35**

for Water Condenser Lines

● Revere Red-Brass Pipe has been used for many years in residential, industrial, commercial, institutional and municipal construction. It is highly resistant to corrosion and can be used where relatively high velocities exist.

Revere Red-Brass Pipe is 85% copper. It is made in standard pipe sizes for use with threaded fittings. In new construction, this pipe has kept the average cost for maintenance and repair surprisingly low. In existing construction, this pipe should be considered where pipe of other material has proved unsatisfactory.

Revere also provides Copper Water Tube for use with solder or compression fittings; type B Copper Tube, for installations requiring outside diameters of SPS pipe and brazed fittings; and Copper Pipe for use with threaded fittings. Every length of Revere pipe and tube is marked with the name Revere. Look for this mark as your assurance of top quality.

Revere pipe and tube are handled by leading distributors in all parts of the country. The Revere Technical Advisory Service is always glad to serve you.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

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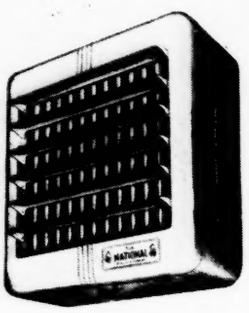
Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.
Sales Offices in Principal Cities, Distributors Everywhere.

Unit Heaters Made in 40 Sizes

National unit heaters which can be used on either steam or hot water heating systems to secure a horizontal or down flow vertical delivery of warmed air, are now being marketed by The National Radiator Co., Johnstown, Pa. This new line of unit heaters for commercial, hospital, factory, public building and institutional space heating, consists of 24 different sizes of horizontal units and 16 different sized vertical units.



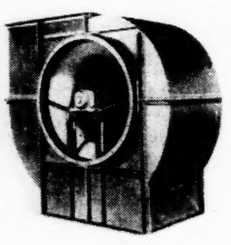
At 2 lb steam and 60F entering air temperature, the new models are rated from 25,900 to 360,000 Btu per hr for horizontal sizes. The vertical units are available from 32,600 to 500,000 Btu per hr. There are also 14 units specially designed to deliver air at low temperatures when used with high temperature steam.

Standard and heavy duty cores are available, both fabricated from seamless copper tubing. Rippled aluminum fins are bonded by a hydraulic expansion of the copper tubes. Fans are of the propeller type and motors are made specifically for fan duty.

For more information, circle on Inquiry Card, **Item 36**

New Line of Centrifugal Fans

Following more than two years of development work, The Trane Co., La Crosse, Wis., announces a completely new and expanded line of centrifugal fans primarily for air conditioning, ventilating, industrial, process and power applications.



The new centrifugal fans can deliver, it is claimed, a required volume of air with horsepower as much as 23% lower than other fans carrying the same rating.

The Trane line includes forward curved fans in 21 sizes from 12- to 89-inch wheel diameters, and backwardly inclined fans in 23 sizes from 12- to 109-inch wheel diameter. Each size is manufactured in single and double widths and in both Class I and Class II construction. The line includes all standard motor and drive arrangements and discharge outlet directions.

The low brake horsepowers required in proportion to the volume of air discharged and the unusually low noise level of the fans are attributed to the following design features: Streamlining of inlets to reduce turbulence and air friction; newly calculated and tested blade angles, depths and widths; scientific balancing of all fan wheels; low outlet velocity and maximum outlet area for each size; heavier gage metals, rigid bracing and sturdier construction.

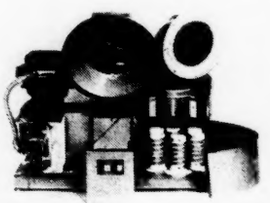
The smaller sized fan housings have convertible lockseam construction, which permits changing direction of discharge on the job. All fans 36-inch and larger have all-welded housings. Largest sizes have split housings to facilitate erection.

Fans are finished with a corrosion resistant coating of chlorinated rubber base enamel. Special coatings and metals can be supplied for unusual corrosive conditions. Three special fan bulletins are available.

For more information, circle on Inquiry Card, **Item 37**

Forced Air Electric Heater

A forced air heavy-duty electric heater, the Speedheater, is announced by Kilbury Mfg. Co., Lawndale, Calif. The unit is approximately two feet square, weighs 70 lb and will fit in a closet, attic, or on the floor. It operates on 220 volts and uses 13,100 watts in developing the equivalent of 45,000 Btu per hr.



Unit is designed for use wherever electricity may be the preferred fuel because of convenience, cleanliness and safety, venting or space requirements, and local fuel rates.

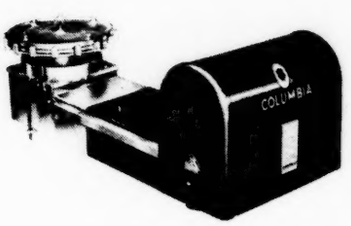
Unit is available in two models, Model 14E is a suspended unit and has a blower which can be set in 22½-degree steps to discharge air at floor, wall, or vertically at ceiling. Model 1450E is a floor or suspended console unit that weighs 115 pounds and stands 34 inches tall, including the 9-inch legs.

For suspended mounting, the console model may be hung on the wall using factory-designed brackets, with mounting hole centers of brackets spaced 32 inches apart so as to fasten to studs.

For more information, circle on Inquiry Card, **Item 38**

Packaged Conversion Burner

The newest in the line of gas conversion burners manufactured by The Columbia Burner Company, Toledo, Ohio, is the Model J, a packaged unit designed for perfect fit and quick, easy installation in any warm air, steam or hot water house heating plant. No interchange of burners is necessary as it performs equally well with natural, manufactured, mixed or L. P. gas.



The Model J has no unnecessary or complicated parts, is made of steel and cast iron, and has no baffles or ceramics. Unit has a single port burner. All gas and air adjustments are under cover, yet accessible if necessary. It has adjustable air shutters, pilot filter and shut-off valve.

For more information, circle on Inquiry Card, **Item 39**

HANDSOME IS AND HANDSOME DOES

Gene Boyle's **Restaurant,** Clifton, N. J. • **Architects:** Shulman & Gurtman, Paterson, N. J. • **Contractor:** B. B. Rider Corp., Passaic, N. J.

...when you specify **kno·draft** adjustable air diffusers

Handsome is . . . the way Kno-Draft *Adjustable* Air Diffusers integrate with *any* decorative theme . . . as soft contrasts in their natural aluminum or, as in the picture above, blended by painting to match the ceiling.

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City.....**Zone**....**State**.....

PRODUCT APPLICATIONS

New, Unusual, or Ingenious Uses of Equipment and Materials

Giant Radiators Disperse Heat

PROBLEM: The new Point Comfort aluminum reduction works at Port Lavaca, Texas, is the largest internal combustion power plant in the world with 120 Nordberg 1800-hp radial engines burning natural gas and each driving a 1000-kilowatt d.c. generator. Scarcity of suitable cooling water at Port Lavaca made necessary a closed water cooling system similar to that used in automobiles.

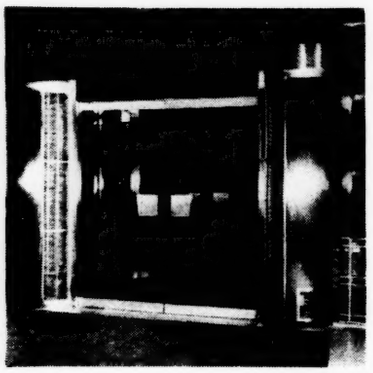
SOLUTION: A bank of 120 giant aluminum fluid coolers, manufactured in the Trane Company's La Crosse plant, was installed. Each cooler consists of cooling coils, fan and casing. Each unit stands 11½ ft high, 13 ft long and 9 ft deep and has a 6-bladed propeller fan 7 ft in diameter. Each unit contains 4 cooling coils with separate cores for cooling engine jacket water and lubricating oil. Air is discharged into aluminum stacks which also carry off the engine exhaust gases and the air used to cool the generators. The coolers consumed half a million pounds of aluminum tubing, sheets, and strips and required 52 freight cars for shipment.

RESULT: Total heat dissipated through the 120 coolers is 317,700,000 Btu per hr. At design conditions each fan draws 78,000 cfm. Four hundred gallons of water per minute are circulated through each unit. Jacket water is maintained between 145F and 155F.

Columns of Heat Balance Door Losses

PROBLEM: To compensate for heat loss of double doors at bank entrances.

SOLUTION: Webster Type WI Radiation was installed in vertical columns at each side of the glass doors in the new Annex office of the Pennsylvania Company for Banking and Trusts, Philadelphia, Pa. The radiation, concealed by grilles, was enclosed within stainless steel columns. A fan also installed within each column blows heated air across the doors.

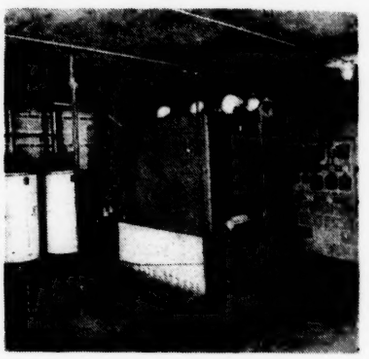


RESULT: Heat loss of doorway is offset by curtain of warm air across entrance. The columns fit in with the interior design of the banking offices.

Penthouse Boiler Saves Storage Space

PROBLEM: The Glaser Drug Company, University City, Mo., occupies the largest of three stores on the ground floor of a 2-story building, second floor of which is occupied by offices and apartments. The drug company requested maximum basement storage space despite blue prints calling for only a partial basement.

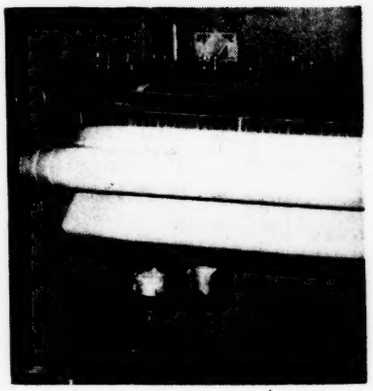
SOLUTION: A National 400 series sectional heating boiler was installed, with oil burner and domestic water heater, in a small penthouse on the roof of the two-story building. The heating contractor raised the boiler to the roof while construction materials hoist was standing. A specially constructed, insulated foundation was specified to prevent undue loss of heat to the floor. Hollow tile was laid on the penthouse cement floor and covered with a course of firebrick, providing a rigid, insulated foundation for the boiler and combustion chamber. An induced draft fan was installed to eliminate the high stack ordinarily required for this size boiler. Condensate is returned to the boiler by a pump in the basement.



RESULT: The building owner was pleased with the installation and Glaser Drug Co. enjoyed unobstructed storage space in the basement.

Unit Trapping Makes Ironer Hotter

PROBLEM: Pyrometer tests made on an 8-roll flat work ironer at Peter Bent Brigham Hospital in Boston, Mass., using one large trap to drain all 8 rolls, showed variation of inlet temperature from 300 to 320F and outlet temperature from 290 to 310F. Ironer speed and percent of work thrown back were unsatisfactory.

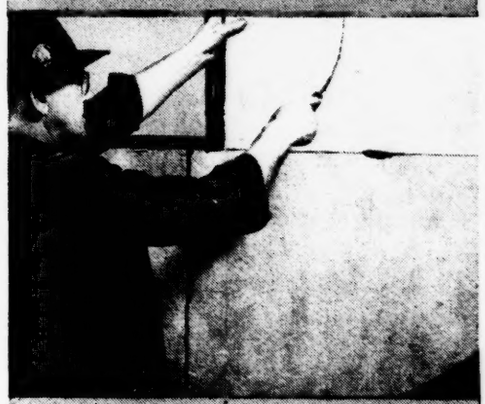


SOLUTION: Armstrong traps were installed on each of the 8 rolls and on the inlet header. Steam pressure was increased 10 lb.

RESULT: Inlet temperature was 340F on each roll (only 7.5 degrees of temperature rise were attributable to the 10-lb increase in pressure). Outlet temperature readings were from 330F to 338F. Mr. Donald Clement, who authorized the installation, points out that ironer speed was increased and throwbacks were eliminated.

This is the Kind of Idea That Wins a Hundred Bucks

"I apply Aerocor with pitch, then secure it with glass tape, and spray paint it."



"I cut Fiberglas Coated Duct on the job with a jackknife."

"I line with Coated Duct the Stik-Clip way, and often cover with Aerocor."

ACT NOW! YOU CAN STILL WIN!

WIN $100!

No Limit to the Number of Winners!

Just answer the question:

WHAT'LL THEY DO NEXT WITH

OWENS-CORNING FIBERGLAS

?

Aerocor* and Coated Duct Insul[illegible]s

Probably you've already earned your hundred bucks—all you have to do now is tell us about it! Surely, someplace in your work you have made an interesting, new, unusual application of Fiberglas insulation. Well, say so—and the money is yours!

These surprising materials have revolutionized insulating practice. They're so adaptable that new applications and application methods come up daily. So—we want to pass the word along nationally. That's the reason for this easy contest. Send in your entry, get the easiest hundred bucks you ever earned!

Rules of the Contest

Write us a letter describing a **NEW OR UNUSUAL APPLICATION OR APPLICATION METHOD** of Fiberglas* Aerocor or Coated Duct Insulation. A letter stands to win **$50 OR $100 IF ACCOMPANIED BY A SNAPSHOT OF THE JOB.** Literary style or quality of photo are not considered in judging. **EACH ACCEPTED ENTRY** receives **$50, OR $100 IF ACCOMPANIED BY A SNAPSHOT.** Judges' decisions are final. Judges are: A recognized Heating and Ventilating Engineer, an Editor of this magazine, an Owens-Corning Fiberglas Corporation Technical Man. All entries become the property of this company. To qualify, an entry must be at the Owens-Corning Fiberglas Corporation office not later than **MIDNIGHT, OCTOBER 30, 1950.**

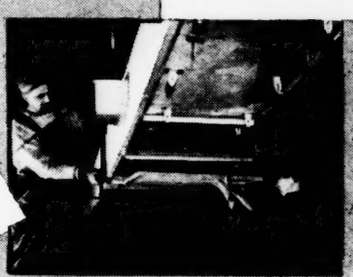
Want an extra hundred dollars? Chances are you already have a likely application! **LET'S GO!**

OWENS-CORNING FIBERGLAS CORPORATION
Dept. 41-I, Toledo 1, Ohio

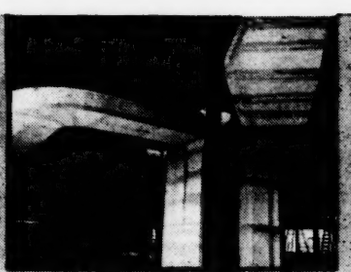
Fiberglas is in your life . . . for GOOD!

*Fiberglas is the trade-mark (Reg. U. S. Pat. Off.) of Owens-Corning Fiberglas Corp. for a variety of products made of or with fibers of glass. Aerocor is a trade-mark of Owens-Corning Fiberglas Corp.

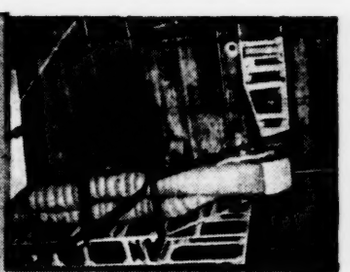
These are typical, everyday uses



Fiberglas Coated Duct Insulation inside and outside a duct. It resists erosion up to 5,000 FPM.



Fiberglas Aerocor on an irregular, heated surface. Weight for weight this insulation has the lowest heat conductivity known.

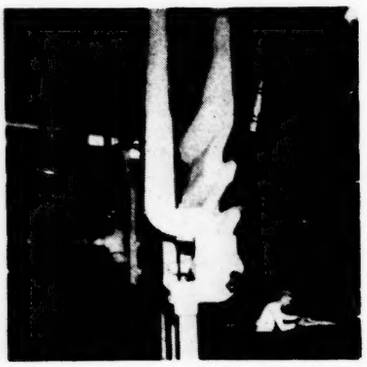


Fiberglas Aerocor applies quickly with glass tape, wire, or an undercoat of pitch or bitumen.

Blanket Insulates Pipe Bank

PROBLEM: To insulate a bank of parallel high temperature steam lines without treating each pipe individually.

SOLUTION: A parallel bank of steam lines leaving from a waste heat boiler to an overhead distributor drum were insulated as a unit with mineral wool blankets and mineral wool insulating material. Application was completed in two steps. First, one inch mineral wool blankets with wire mesh backing on both sides were wrapped around the entire bank of pipes and secured in place. Blankets were butted tightly together. Second, a ½-inch coating of mineral wool cement was troweled over the blanketing.



RESULT: Installation time and cost were reduced. Space occupied by parallel pipes was reduced. No specially sized pipe insulation was required.

Steel Boiler Delivered Through Indoor Stairway

PROBLEM: To replace a steel boiler in the Spurgeon Building, Fairfield, Iowa, where there is no entrance to the basement from outside either front or rear.

SOLUTION: Master Plumbers Supply Co., Inc., distributors for National Radiator steel boilers, removed an 8 by 10 ft plate glass window immediately after store closing. The steel boiler was moved in through the display window and skidded through the store to the top of a stairway. Planking was laid on the stairs and boiler slowly skidded into the basement.

RESULT: By nine o'clock in the evening, a delivery deemed impossible had been made, planking was taken up and plate glass replaced.

Vermiculite Concrete Insulates Dry Kilns

PROBLEM: Dry kiln operators are faced with loss of heat and steam and overloading of boilers resulting from excessive heat loss from walls and roofs of kilns.

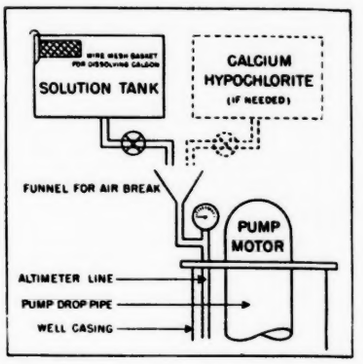
SOLUTION: In some successful cases, vermiculite, a lightweight aggregate processed by the Zonolite Co. of Chicago, is used instead of sand in the concrete mixes used in fabricating kiln roof slabs. The vermiculite slab is usually applied 3 to 6 inches thick over the existing roof. Roofing material is then applied.

RESULT: Many kilns, which previously had operated only part time due to boiler overload, have been switched to full-time operation after placing of vermiculite slabs over the existing roof. No roof reinforcement is required because vermiculite concrete weighs only 25 to 35 lb per cu ft.

New Cleaning Method Revives Old Wells

PROBLEM: A large refinery had been forced to abandon 25 utility water wells over an 18-year period. Porous concrete casings in many of these made acid cleaning impractical. Columns of clay and fine silt, which are not affected by acid cleaning, as well as deposits of iron oxide and calcium carbonate, have made the wells inoperable. It was necessary to find a new cleaning method that would give economical results.

SOLUTION: A new cleaning method developed by Calgon, Inc., Pittsburgh, Pa., makes use of the vitreous sodium phosphate already in widespread use as a water conditioning agent. This material is noncorrosive to either metal or concrete during the short contact periods required. Wells that have lost capacity because of plugging or clogging were cleaned without removal of equipment. Periodic cleaning of the wells then was adopted as standard procedure to maintain their capacity.

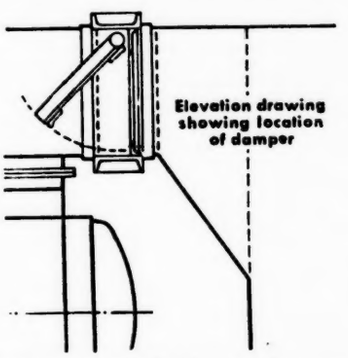


RESULTS: The manager of the utilities department reported that the method is simple and practical and that the chemicals involved are readily obtainable, safe to handle, and low in cost. Wells to be cleaned were removed from service for a period of 24 to 48 hrs. Clay and silt is disposed of by cleaning agent. Use of the method in a group of 24 wells has added average life of 4 years, restored to their original capacity after 3 years, and periodic cleaning thereafter maintained their original capacity and prolonged their service life.

Heacon Damper Saves Fuel

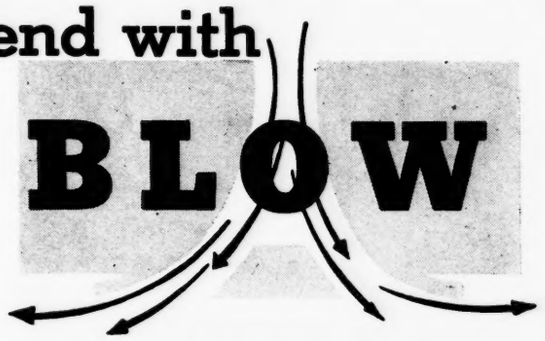
PROBLEM: A 200 hp Keeler boiler operating an engine generating set, pressing machine, ironers, and a hot water generator in a Philadelphia laundry had to be fired at 1:00 a.m. in order to make 30 psig of steam available by 6:30 a.m.

SOLUTION: A leaf type Heacon damper was installed. Thermix Corp. of Greenwich, Conn., describes the damper as having a flexible sealing medium of asbestos that reduces the possibility of leakage yet permits freedom from binding.



RESULT: Since installation of the damper, the 1:00 a.m. firing has been eliminated and boiler pressure at 6:00 a.m. is now 109 psig, only 16 lb below normal operating pressure. The laundry reports savings up to 300 gallons per week in oil consumption besides eliminating the need of an attendant for midnight firing. The cost of damper installation was amortized in a little over 5 months.

Why contend with BLOW



The Main Source of Air Conditioning Complaints?

THESE EXCLUSIVE MULTI-VENT ADVANTAGES RESULT FROM THE ABSENCE OF BLOW:

- Complete absence of draft velocities.
- Unparalleled uniformity and control of air temperature and air motion.
- Elimination of all air direction adjustments by diffusing vanes or baffles.

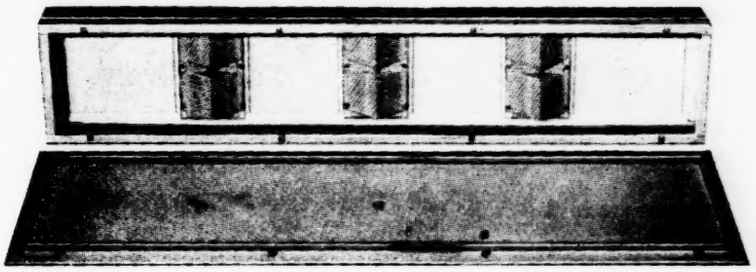
Specify MULTI-VENT (T.M. REG.) *CEILING PANELS*

Through perforated ceiling areas, Multi-Vent provides perfect overall air distribution entirely by pressure displacement—completely free from BLOW or high velocity injection. BLOW is the direct source of all draft hazards and is responsible for the most serious installation, balancing, maintenance and adjustment problems.

- No restrictions on the location of diffuser, regardless of walls and columns.
- Partitions may be moved at will, even to bisect a panel.
- More room air changes per hour, when required, with less air motion.
- Elimination of dirt impingement on ceiling and wall surfaces.
- Higher Diffusion Temperature Differentials with lower ceilings.
- No change in air diffusion pattern or cold drop when volume of air delivered is varied.
- Complete absence of the sound of rushing air.
- Complete concealment behind standard perforated acoustical ceiling pans.

New THE MODULAR ONE-FOOT MULTI-VENT PANELS . . .

Available in 2, 3, 4, 5, and 6-foot lengths, supplementing the line of two-foot and three-foot wide panels.



MULTI-VENT PANEL WITH PERFORATED DISTRIBUTION PLATE LOWERED
(Standard metal acoustical pans may be substituted for the distribution plate)

For comparatively small air volume requirements in new modular construction.

For long narrow peripheral zoning.

For economical installation in standard suspended ceilings.

For beautiful ceiling design with parallel strips of one-foot flush troffer lighting.

Write for detailed literature and the name of the Multi-Vent sales engineer in your vicinity.

● *MULTI-VENT DIVISION*
THE PYLE-NATIONAL COMPANY
1374 N. KOSTNER AVE., CHICAGO 51, ILL.

NEWS OF THE MONTH

CENSUS BUREAU

reports on air conditioning and commercial refrigeration equipment, 1949

Shipments of components and accessories for air-conditioning and commercial-refrigeration equipment in 1949 were valued at $132 million, down 20% from 1948. This decline was due primarily to a decrease in value of shipments of condensing units from $73 million in 1948 to $54 million in 1949. Shipments of heat-exchanger equipment also declined substantially, dropping from $49 million in 1948 to $40 million in 1949. Shipments of compressors and compressor units in 1949 were valued at $30 million, 11% below the previous year, while centrifugal-refrigeration systems shipped in 1949 were valued at $8 million, about $2 million less than shipments in the preceding year. Shipments of self-contained air-conditioning units totaled $50 million in 1949, a slight gain over 1948 and about four and one-half times as great as shipments in 1945.

• **SCOPE.**—The shipment figures included in this report, prepared by the Industry Division, Bureau of the Census, represent completed sales of equipment, i.e., units actually billed and shipped. Complete units delivered on consignment or shipped to a branch warehouse for stock are not included until such time as they are actually sold. The dollar values shown are the manufacturers' net billing prices, f.o.b. factory.

The Bureau report presents data for virtually every company manufacturing components and accessories for air-conditioning and commercial-refrigeration and complete air-conditioning equipment. The 1949 figures are based on reports received from 93 companies. Data previously published for 1948 represented only 71 companies, but this release contains revised 1948 figures based upon the addition of data for four sizable companies which were not originally included in the survey for that year. The rest of the difference in the number of companies included in the survey for the two years represents small concerns active in 1948 as well as in 1949 but not included in the statistics for the former year. These manufacturers accounted for less than 2% of the total value of shipments of 186 million in 1949.

Table 1 presents a summary of equipment shipments.

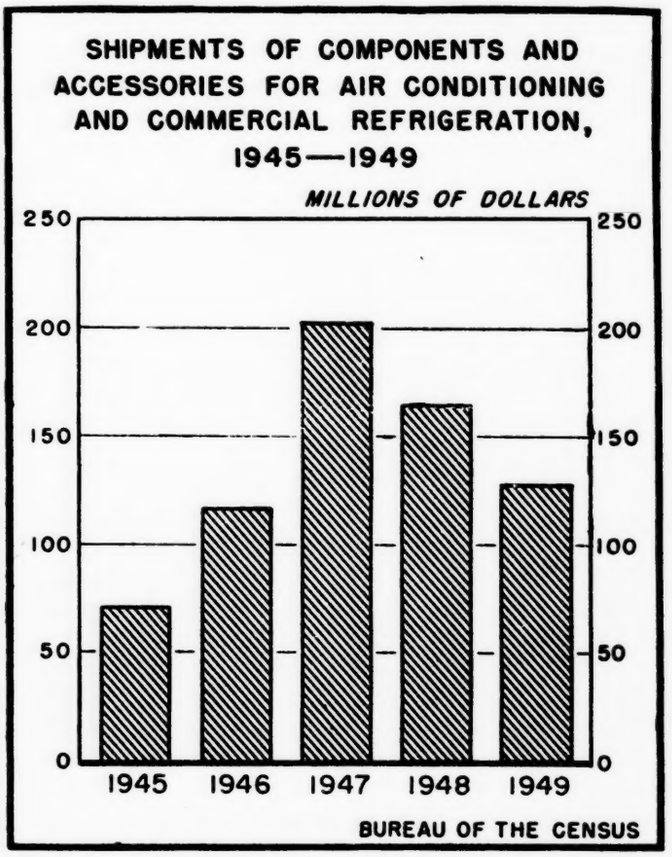


TABLE 1. SHIPMENTS OF AIR CONDITIONING EQUIPMENT AND COMPONENTS AND ACCESSORIES FOR AIR CONDITIONING AND COMMERCIAL-REFRIGERATION EQUIPMENT, BY CLASS OF PRODUCT: 1948-1949

Class of Product	1949 Number	1949 Value[1]	1948[2] Number	1948[2] Value[1]
Condensing units	610,341	$53,534	841,609	$73,443
Ammonia refrigerants	254	346	1,129	1,799
Refrigerants except ammonia	610,087	53,188	840,480	71,644
Air-cooled	570,280	40,127	797,098	56,829
Water-cooled	39,807	13,061	43,382	14,815
Condensing units, not reported by type	.....	.....	.....	.....
Compressors and compressor units	601,810	29,771	459,390	33,493
Ammonia refrigerants	2,240	5,620	4,156	9,209
Refrigerants except ammonia	599,570	24,151	455,234	24,284
Compressors and compressor units, not reported by type	.....	.....	.....	.....
Centrifugal-refrigeration systems	285	8,189	361	10,351
Heat-exchanger equipment	.....	40,352	.....	48,552
Evaporative condensers	5,147	5,646	5,560	7,505
Unit coolers	96,839	16,671	102,825	17,874
Air-conditioning	30,695	8,102	21,633	8,276
Refrigeration	66,144	8,569	81,192	9,598
Other heat-exchanger equipment	.....	18,035	.....	23,173
Heat-exchanger equipment, not reported by type	.....	.....	.....	.....
Self-contained air-conditioning units	123,407	49,980	111,620	49,008
Room-type	89,320	17,940	73,638	15,503
Other than room-type	34,087	32,040	37,982	33,505
Ice-making machines	6,523	4,434	5,947	5,266

[1]Money figures in thousands of dollars.
[2]Revised.

Now, that's a brand we know!

Jane and Joe America have *definite* ideas of brands they prefer in everything from cigarettes to motor cars. And when they think of modern heating, it's *Bryant automatic gas heating* that rates first!

That's true, too, of the nation's business executives to whom you sell your services on large heating and ventilating contracts. They recognize Bryant as a name known for quality through nearly a half century . . . prefer boilers, unit heaters, conditioners and water heaters bearing that famous nameplate.

Look at these other advantages to you. A distributor close enough to know local needs . . . maintaining a stock that permits you to order most everything in gas heating from a single source . . . offering helpful engineering assistance on your industrial, commercial and institutional projects.

Like to have clients nod quick approval when you present your specifications? That can be a regular occurrence when you specify Bryant . . . *the brand they know best!*

Let the pup be furnace man
. . . and water boy, too!

bryant

AUTOMATIC HEATING

The most complete line of gas heating equipment in the nation

Bryant Heater Div., Dept. 147,
Affiliated Gas Equipment, Inc.,
17825 St. Clair, Cleveland, Ohio

( ) Send me the new booklet that tells the Bryant story. ( ) Have your distributor call on me.

Name_____

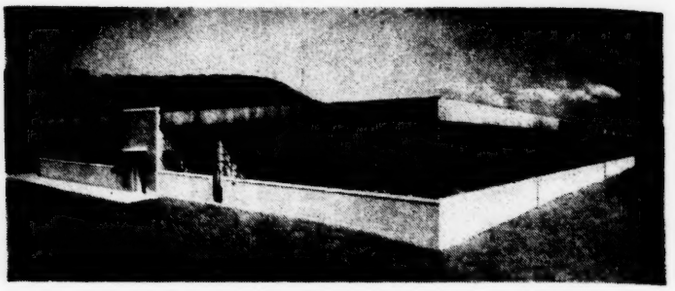
Company_____

Address_____

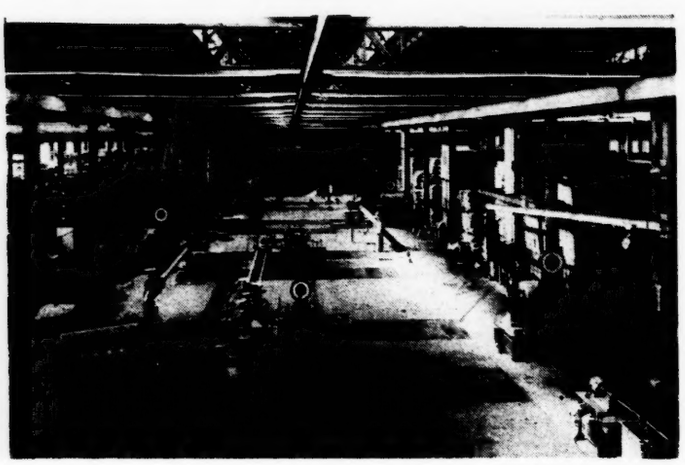
City_____ State_____

News Pix

Dr. Willis H. Carrier, who invented the centrifugal refrigeration machine in 1921, is shown with the 2,000th such unit to be produced by Carrier Corporation. This particular machine, designed to produce a temperature of 85 degrees below zero, was designed for the Eastman Kodak Company in Rochester for use in film processing work.



W. B. Connor Engineering Corp., manufacturers of Dorex activated carbon air recovery equipment and Kno-Draft adjustable air diffusers, announce the removal of their main offices, plant and laboratories from New York to a new plant constructed in Danbury, Conn. The first new plant unit, a single story structure of 40,000 sq ft on a ten acre plot, has been designed for assembly line production of all company products and includes a large research area for work in the fields of air purification, distribution, and diffusion. Construction will begin shortly on a greenhouse and cold storage plant for atmosphere control experiments in flower cultivation and food storage. Facilities and equipment for the evaluation of odor removal techniques covering wide variations of air temperature, odor concentration, humidity, air flow, etc., will be available together with apparatus for the investigation of the sense of smell and the physical and chemical properties of solid surfaces affecting the retention or removal of odors. The influence of the atmosphere on the preservation of perishables will be a major project.



(Left) General view showing eight test stations in the new quarter million dollar pump testing laboratory at the Indianapolis Works of the Peerless Pump Division of the Food Machinery and Chemical Corp. Pumps of all sizes and capacities from 5 to 86,000 gallons a minute and from 1 to 1000 hp can be accurately tested to ½ of 1% efficiency in this laboratory, which is said to be the biggest of its kind in the United States.

COAL-TO-OIL PLANT

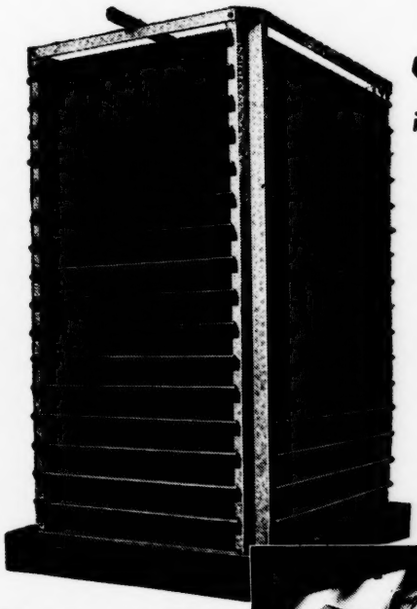
nears completion in Bureau of Mines search for data on commercial synthetic fuels production.

Major construction on the Bureau of Mines gas-synthesis demonstration plant at Louisiana, Mo., an 80- to 100-barrel-a-day unit that will convert coal to oil by a modified Fischer-Tropsch process, was completed early in August.

First of its type in this country, the plant was built under the Bureau's synthetic liquid fuels research and development program to translate laboratory data into cost and engineering information directly useful to industry in planning, building, and operating commercial-scale installations (5,000 or more barrels daily). Koppers Co., Inc., of Pittsburgh, Pa., held the $4,915,000 design and construction contract, now completed.

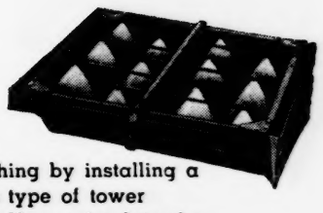
Much remains to be done, however, before the plant begins integrated operations early next year. Some work remains on the piping insulation and road sub-contracts. Large quantities of synthesis catalyst must be prepared and reduced on the site before initial operation. In addition, tests and partial runs will have to be made to prove the operability of the various units and the ability and skill of the operating staff.

• **PROCESSES.**—This demonstration plant, the second built at Louisiana, Mo., will gasify pulverized coal with oxygen and superheated steam and then convert the resulting synthesis gas—a mixture of carbon monoxide and hydrogen—to liquid fuels by passing it over



SLASH your cooling water cost

install a **Binks** *natural draft cooling tower*



You can cut your cooling water bill to almost nothing by installing a Binks Type "S" Natural Draft Cooling Tower. This type of tower is excellent where air movement is unrestricted*. You recirculate the same water over and over, passing it through the cooling tower each time. A small pumping cost replaces high water bills.

Binks Type "S" Cooling Towers are made in a variety of types and sizes, handling from 15 to 1200 gallons per minute with high efficiency. These towers will provide you with many years of trouble-free service.

ideal for many applications

Binks Type "S" Cooling Towers are the accepted standard for cooling condenser circulating water from refrigeration and air conditioning compressors...for cooling water-jacketed engines...or for low-cost cooling in many manufacturing processes where heat is dissipated by spraying water or other fluids.

**Ask about Binks Mechanical Draft Towers for locations where air movement is limited.*

Binks clog-proof Rotojet spray nozzles contribute much to the high efficiency of Binks towers. Their side-inlet, whirl-chamber design and precision manufacture assure maximum fluid break-up and long life.

Send today for FREE Bulletins

which give full information about Binks Type "S" Towers:

Bulletin 30—Single section towers
Bulletin 31—Multiple section towers
Bulletin 32—Large capacity towers
Bulletin 40—All Redwood towers

Please state how tower will be used, also capacity required.

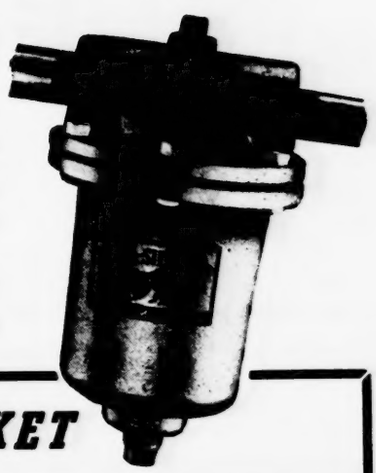
THERE'S A BINKS TOWER FOR EVERY COOLING JOB

Binks MANUFACTURING COMPANY

REPRESENTATIVES IN ALL PRINCIPAL CITIES ■ 3120-38 CARROLL AVENUE, CHICAGO, ILL.

TIME TO EQUIP UNIT HEATERS

with SUPER-SILVERTOP *steam traps*



Winter is just around the corner. That means it's time to equip unit heaters with Super-Silvertop steam traps. Super-Silvertops pay for themselves by making unit heaters give out more heat at less fuel cost. By keeping out all water, Super-Silvertops permit the coils to be completely filled with hot dry air. Super-Silvertops work when other traps fail because they're *activated by water only regardless of temperature.* For an economical, warm winter, order Super-Silvertops installed on every unit heater today. See your representative or write us direct.

THE V. D. ANDERSON COMPANY
1943 WEST 96th STREET • CLEVELAND 2, OHIO

Only Super-Silvertop has a GUIDED BUCKET

catalyst. With American modifications, the Fischer-Tropsch process is well-adapted to the production of a good-grade motor gasoline and an excellent Diesel fuel. Available byproducts include alcohols, wax, aliphatic acids, and hydrocarbon gases. Any rank of coal from anthracite to lignite may be used. In Germany, the use of this process increased gradually until January 1944 when the capacity of the Fischer-Tropsch plants reached a wartime peak of 10,000 barrels of product daily.

The first demonstration unit completed by the Bureau of Mines at Louisiana, the 200- to 300-barrel-a-day Hydrogenation Demonstration Plant, has been in experimental operation since early in 1949. It employs another basic process (Bergius) of German origin for converting coal to liquid products ranging from high-octane aviation gasoline to heavy fuel oils. This process is applicable to all coals except anthracite and low-volatile bituminous and was used by the Germans to produce most of their wartime aviation gasoline.

• **UNITS.**—The new Gas-Synthesis Demonstration Plant, incorporating advances made in the Bureau's broad research program, consists of five units: (1) Oxygen production; (2) coal gasification; (3) gas purification; (4) hydrocarbon synthesis; and (5) distillation or product recovery and refining. Standard equipment was used wherever possible throughout the plant. Special designs were required in some instances, however, where there was little or no precedent in American industry.

Bureau modifications of the German process are centered in the method of producing and purifying the synthesis gas, the use of a rugged iron catalyst, and in the synthesis reaction system which employs a "jiggling-bed," internally-cooled converter. Designed to permit better control of the process, these improvements should eliminate many operational troubles that continually plagued the Germans.

• **OXYGEN PRODUCTION.**—Oxygen is extracted from the air at temperatures more than 300F below zero in a one-ton-per-hour Linde-Frankl unit originally built for I. G. Farbenindustrie chemical operations at Hochst, Germany. This unit supplies 98% pure oxygen to the gas-producing units and has given fully satisfactory service since reconditioned and put in service in December 1948. The relatively few changes made were confined largely to the electric motors, flanges, and control instruments, which were adapted to American practice or replaced with American equipment.

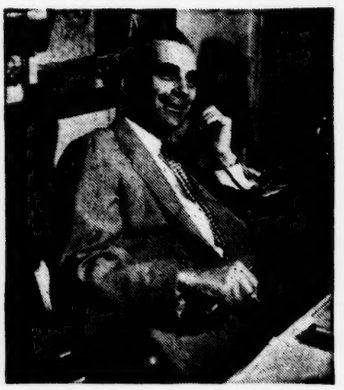
STEEL BOILER INSTITUTE

stresses advantages of ASME construction code at annual meeting.

The potential danger to the public in the purchase, installation, and use of steel boilers not made in accordance with the Boiler Construction Code of the ASME was emphasized in discussions at the 22nd annual meeting of the Steel Boiler Institute at the Seaview Country Club, Absecon, New Jersey, June 13.

Due to the shortage of steel plate, a considerable number of residential type steel boilers has been made

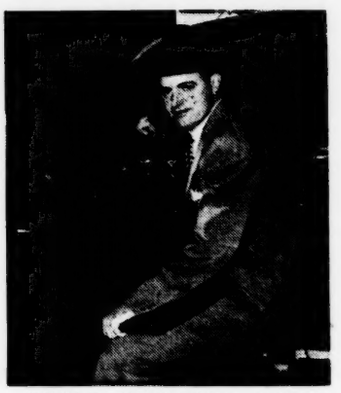
These men are working for you



Energetic, keen-minded JOHN G. SEILER, Tube Turns' Executive Vice-President and General Sales Manager, keeps a sensitive finger on the pulse of your piping needs.

Solid, wiry JOHN W. GREEN, Sales Manager of Tube Turns' Fittings Division, arrives in New York for confab with Eastern representatives.

Rangy, quick-smiling THOMAS H. PIKE, Jr., Assistant Sales Manager of Tube Turns' Fittings Division, awaits flight call for personal check on West Coast piping picture.



JOHN E. CHUMBLEY, slender, youngish Sales Manager of Tube Turns' Forgings Division, makes frequent field trips that pay off in better products, faster service.

MOST travel-minded group of American businessmen today are sales executives. Covering millions of air, rail, and highway miles each year, these modern Marco Polos have chucked the Ivory Tower attitude of their predecessors.

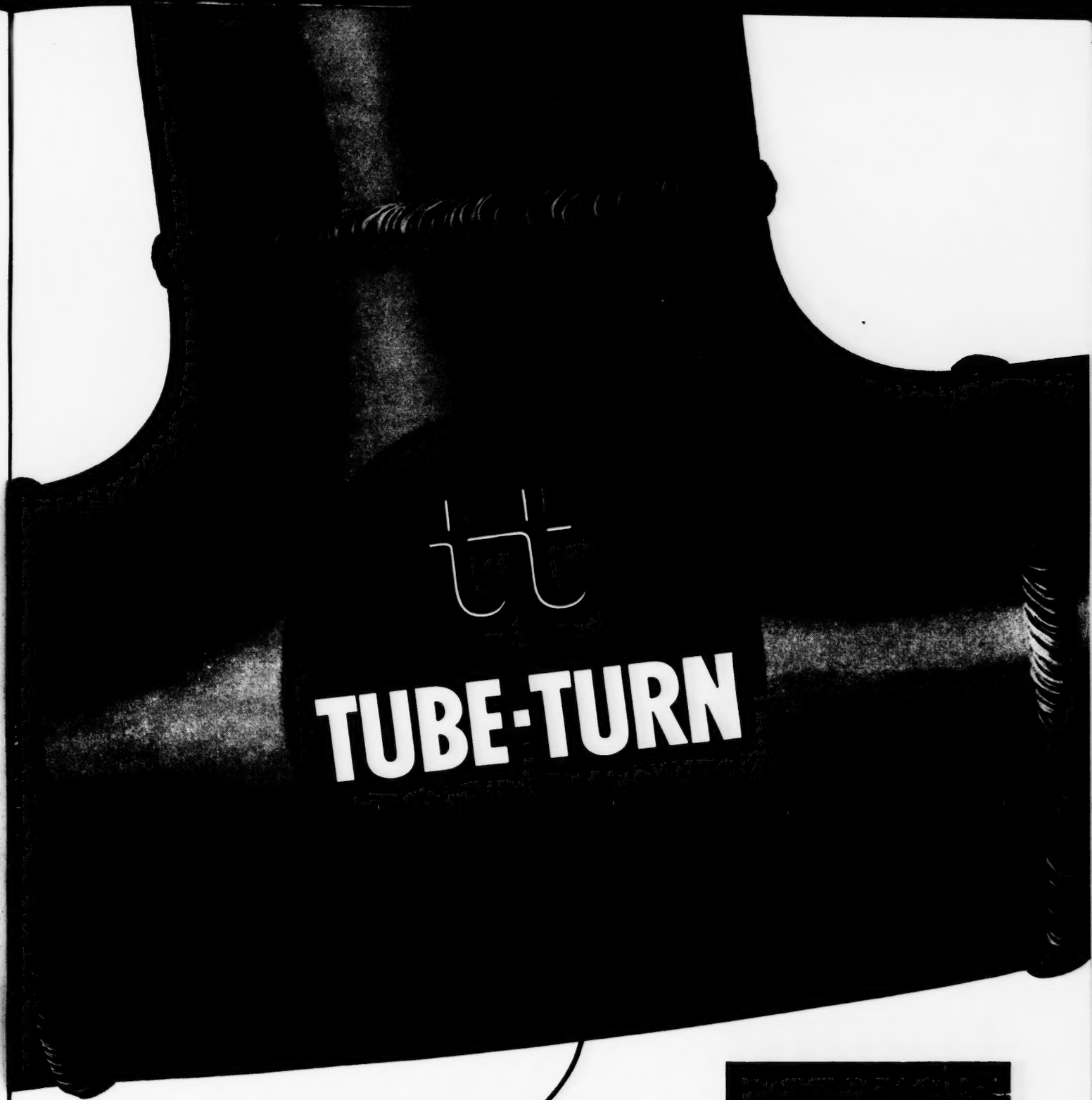
Like many another sales management team, John Seiler, Jack Green, Tom Pike and John Chumbley look upon service as the father of sales. "Our customers are smart," confides Seiler. "They don't just *buy*, they *discriminate!* Field trips are the best way I know to find out how we can serve them better. It takes plenty of leg work in this business. Your customer can usually give you some pretty solid ideas on product improvement. We've prospered because we listen to what he says . . . *in person!*"

Some 2200 distributor salesmen, the sales-engineering staffs of Tube Turns' 8 district offices, and the finest group of piping technicians in the industry, follow this customer-service policy to the letter. Results: Tube-Turn welding fittings and flanges are the best in the company's history; Tube Turns' customers get qualified help in utilizing its products more and more profitably.

"Be Sure You See The Double tt"

TUBE TURNS, INC.

LOUISVILLE 1, KENTUCKY



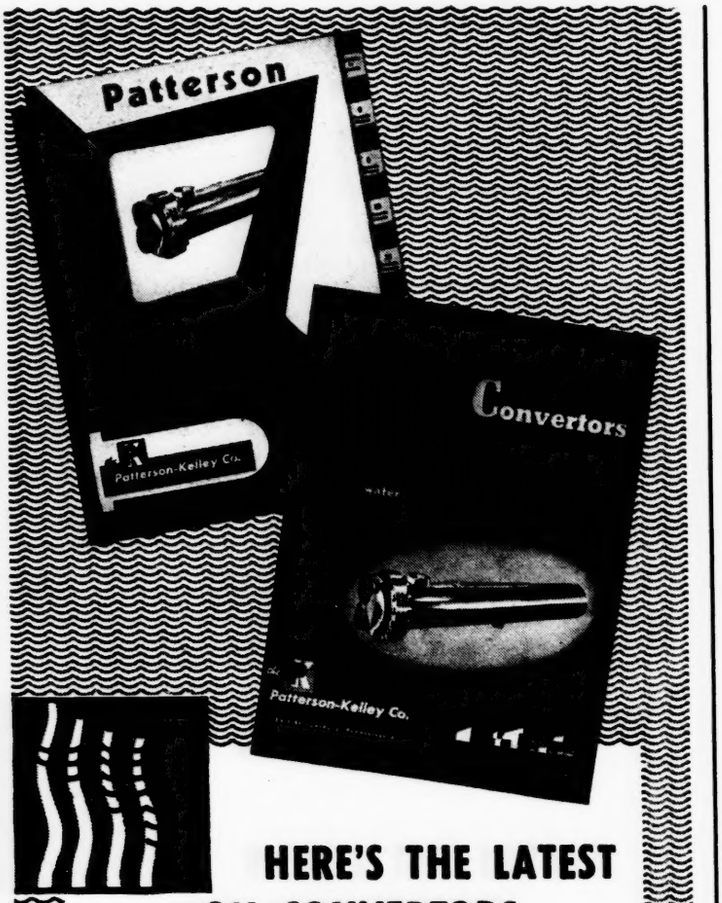
In all the world there's only one TUBE-TURN Welding Fitting as shown by this trade mark... the right mark for every need in welding fittings and flanges.

More than ever, the services of your TUBE TURNS Distributor can be important to the smooth operation of your business.

TUBE TURNS, INC., LOUISVILLE 1, KENTUCKY DISTRIBUTORS IN ALL PRINCIPAL CITIES

DISTRICT OFFICES: NEW YORK • PHILADELPHIA • PITTSBURGH • CHICAGO • HOUSTON • TULSA • SAN FRANCISCO • LOS ANGELES

In Canada . . . Tube Turns of Canada Limited, Chatham, Ontario

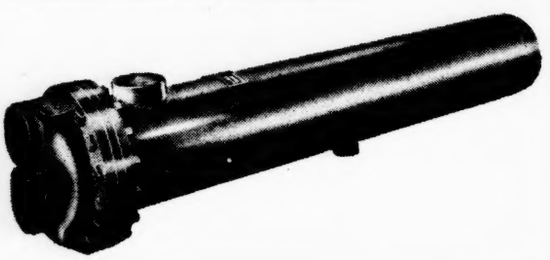


HERE'S THE LATEST ON CONVERTORS . . . AND INSTANTANEOUS HOT WATER HEATERS . . .

You're sure to find these two new p-k catalogs valuable additions to your "right-at-hand" design data files! They give you the current data on steam-to-water heating installations for top *efficiency* and *economy*.

Catalog No. 202 presents the technical aspects of p-k Instantaneous hot water Heaters in thirty-six data-packed pages. Catalog No. 303 details the features of p-k Convertors. Both give complete dimension tables, general construction details, and capacity and pressure drop tables.

Write for your copies of these two ready reference manuals. Yours, without obligation.



the **Patterson-Kelley Co., Inc.**

6960 93 BURSON ST. E. STROUDSBURG, PA.
Offices and Representatives in Principal Cities

with inferior material. Boilers have been designed without reference to the minimum safety rules established by the ASME Boiler Construction Code, it was pointed out at the meeting.

• **DANGER.**—These non-code boilers not only injure the reputation of steel boilers, but are dangerous and a menace to life and property.

In his report as chairman of the Sales and Distribution Committee, Paul K. Addams said:

"The rating on non-code boilers is set by the manufacturer and often results in the installation of boilers that are incapable of furnishing sufficient heat.

"The descriptive advertising of some of the non-code boilers contains such references as 'rated in accordance with the SBI formula' and 'Complies with minimum requirements of ASME.' Such statements are improper and the manufacturers making them have ignored the fact that the most important section of the SBI Rating Code is the one which requires test data as the basis of rating. They have also ignored the fact that one of the most important sections of the ASME Boiler Construction Code is the one that requires shop inspection by a disinterested licensed inspector."

Mr. Addams pointed out that it was the unanimous opinion of his committee that every effort should be made to obtain wider acceptance of SBI ratings and ASME construction and that the FHA should be encouraged to enforce these requirements as a protection to the homeowner and to the lending agencies.

• **NEW CODE.**—R. A. Locke, president of the Steel Boiler Institute, reported that during the past year SBI Rating Codes for Scotch Type Boilers were printed and issued to the industry. Mr. Locke also reported that Simplified Practice Recommendation R157-37 was revised and reissued as Simplified Practice Recommendation R157-50.

Edward A. Livingstone and L. E. Jeanneret of Babcock & Wilson Tube Co. discussed research work directed toward the improvement of boiler tubes.

William Ferguson, chairman of the American Uniform Boiler-Law Society, spoke on the work of the society, particularly with reference to the standardization and simplification of the laws pertaining to the installation of steel boilers.

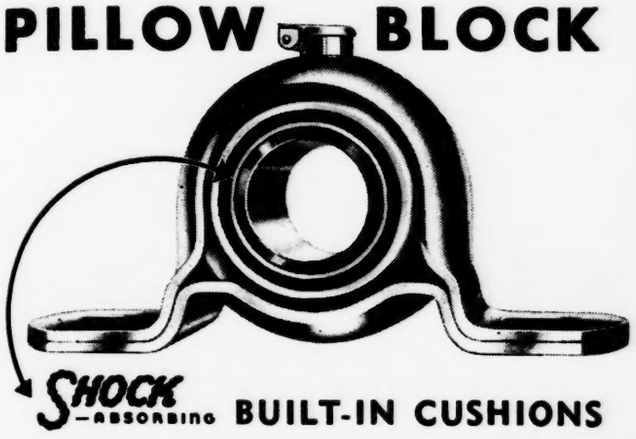
A silent period was observed in memory of Robert B. Dickson, one of the founders of the Steel Boiler Institute, who served as president during very critical periods. A resolution expressing the appreciation of the members for the many services performed by Mr. Dickson was adopted.

• **OFFICERS.**—The following directors were elected for three-year terms: J. T. Dillon, J. F. Johnston, Jr., and H. H. Peek, Jr. Other members of the Board are Elbert M. Palmer and Paul K. Addams.

Officers were re-elected as follows: R. A. Locke, president; Arthur P. Weiss, vice president. John C. Trefts was named chairman of the executive committee, a new position.

• R. M. Barnes, northeastern sales and service manager of the Dravo Corp. Heating Department, will be in charge of a new Boston sales office at 79 Milk Street.

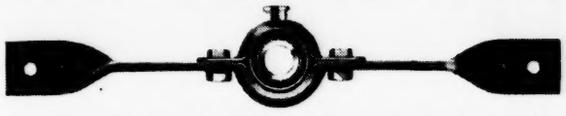
TRIANGLE
PILLOW BLOCK



SHOCK-ABSORBING BUILT-IN CUSHIONS

- For fans, blowers and other devices requiring self-lubrication, perfect alignment, silent operation—with minimum attention.
- Low prices include built-in, non-hardening synthetic rubber cushions. It's ALL in the ball—no extra parts to buy or handle!

SPECIAL MOUNTINGS DESIGNED TO MEET SPECIFIC NEEDS



Triangle Bridge-Tree Type Pillow Block

TRIANGLE MANUFACTURING CO.
396 DIVISION STREET OSHKOSH, WISCONSIN

ANNOUNCING

A NEW, LOW PRICED
Skinner drip-eliminator *Valve*
or shut-off

for better oil burner service!

Model V2-100

You can't beat the NEW V2-100 Solenoid Valve for dependability on original burner equipment or for service satisfaction. This very compact valve has such quality features as sturdy steel construction with all parts plated to resist corrosion — soft synthetic seat and seals to prevent leakage — spring loading for positive closing — *no* brazed, welded or soldered pressure *joints* — usable in any position — weight, only 9 oz. Maximum pressure is 125 p.s.i. The NEW V2-100 is two-way, normally closed, rated at 10 watts maximum and is Underwriters' approved.

Write for details and low prices!

Skinner ELECTRIC VALVE DIV.
THE SKINNER CHUCK COMPANY
136 Belden Ave., Norwalk, Conn.

■ *Designed for Quick, Easy Installation*

AIRTHERM
CONVECTORS

Attractive appearance, outstanding performance, and ease of installation have led to an increasing preference for Airtherm Convectors in institutions, apartments, homes and schools. Try AIRTHERM Convectors on your next job.

Airtherm Cabinet design permits quick, easy assembly.

FOR HEATING SATISFACTION...
Think First of AIRTHERM

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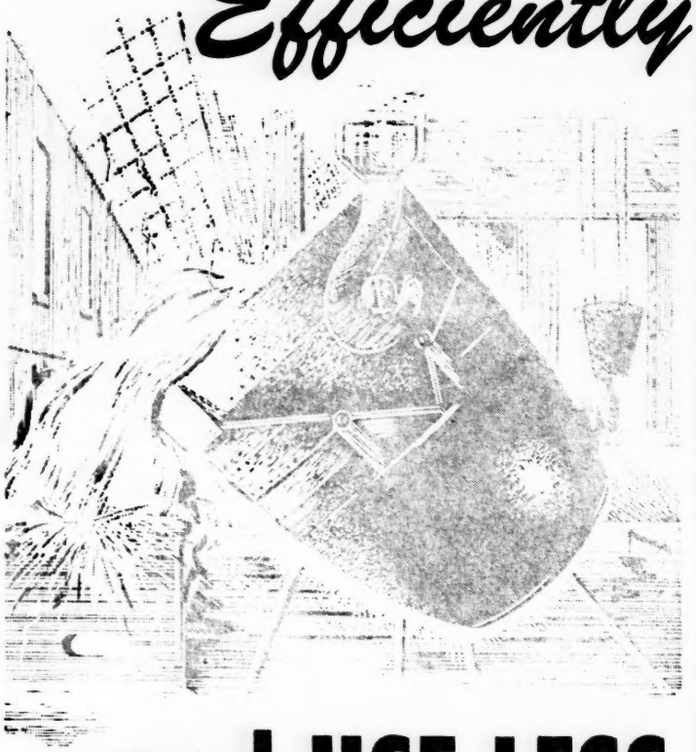
HEAT YOUR PLANT *Efficiently*



...and USE LESS *Steel*

Direct-Fired, Self-Contained Heaters like THERMOBLOC go high on the priority list when steel allocations are enforced; because, they require ⅓ to ½ the steel of conventional type heaters.

THERMOBLOCS provide the most economical method of heating your plant and, in addition to this drastic saving in steel, offer the simplest installation problem possible.

THERMOBLOCS are available in five sizes, 100,000, 200,000, 300,000, 550,000 and 1,000,000 btu's output per hour. Within this range is the heater to fit your requirement. Multiples or combinations of any of these sizes will amply heat any size plant, providing a flexibility to suit your particular problem.

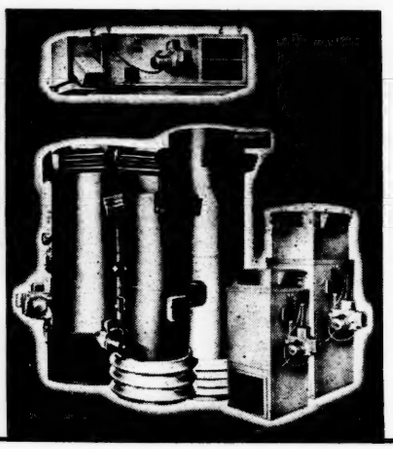
Learn about THERMOBLOC, the most economical heater on the market today. Ask for the new, up-to-date Technical Bulletin, giving a wealth of information on heat loss of various building materials and methods of calculating heating requirements.

THERMOBLOC TYPE

Model 300
Output 300,000 btu's hr.
Covers 1600 to 2400 sq. ft.

Model 550
Output 550,000 btu's hr.
Covers 4500 to 6500 sq. ft.

Model 1000
Output 1,000,000 btu's hr.
Covers 8,000 to 12,000 sq. ft.



THERMOPAC TYPE
Floor Set or Suspended

Model 100
Output 100,000 btu's hr.
Covers 800 to 1200 sq. ft.

Model 200
Output 200,000 btu's hr.
Covers 1600 to 2400 sq. ft.

THERMOBLOC DIVISION
PRAT-DANIEL CORPORATION
Manufacturers of Prat-Daniel Power Equipment
86-9 WATER ST. E. PORT CHESTER, CONN.

NEW REFRIGERATION CODE

issued by ASA and ASRE has wide approval

Intensive investigation of the safety of refrigeration equipment, covering both its design and installation in the light of present experience, has resulted in a complete revision of the American Standard Safety Code for Mechanical Refrigeration.

Almost everyone is affected in one way or another by the provisions of this code because it applies to electric refrigerators in homes and apartments, to the air conditioning systems in theaters, restaurants, department stores and elsewhere, to skating rinks, and to ice-making plants, cold storage plants, ice cream factories, and other industrial applications.

• **APPROVED.**—The new revision has the approval of 36 national organizations. These organizations, under the technical leadership of the American Society of Refrigerating Engineers, include several technical societies and trade associations in the refrigeration and air conditioning field. Also included are the National Safety Council, casualty and fire insurance groups, National Fire Protection Association, U. S. Department of Labor, National Bureau of Standards, American Society of Mechanical Engineers, Manufacturing Chemists' Association of the U. S., Building Officials Conference of America, and others. In order to obtain a consensus of these organizations, nine drafts were prepared during a period of more than two years. The revision is the first since 1939.

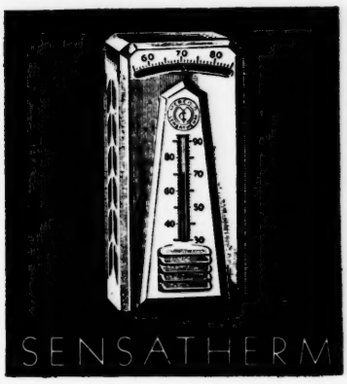
The newly revised code, like the 1939 code, is expected to serve as a recognized authority for minimum safety in design and installation, uniformly acceptable to enforcement authorities. Many cities have adopted the 1939 code in full and some have already provided for adoption of the new code. Among the latter are Akron and Cleveland, Ohio, Ft. Lauderdale, Fla., and Memphis, Tenn.

• **FUNCTION.**—If uniformly adopted throughout the country, refrigeration equipment could be installed everywhere without alteration in the field because it will be manufactured to conform with code requirements. This is important from the standpoint both of safety and economy. Formulators of the code emphasize the importance of adopting the entire code rather than portions of it or with its provisions altered by anyone not familiar with the interdependability of all provisions.

• **PROMOTION.**—To assist in the use of nationally recognized standards and codes in state laws and local ordinances, ASA has published a report of a special committee to present the problem and possible solutions. Among 33 organizations represented on this committee were the Council of State Governments, National Conference of Commissioners on Uniform State Laws, National Institute of Municipal Law Officers, U. S. Chamber of Commerce, U. S. Conference of Mayors, U. S. Department of Commerce, as well as interested engineering societies and trade associations. This report, a 44-page booklet, is available from ASA.

• **REVISIONS.**—In general, the new version of the code has been considerably simplified and is considerably more comprehensive than the 1939 code. The major over-all change is perhaps the result of cooperation

If they are,



MERCOID CONTROLS

You can always count on their fine engineering to give very dependable service for a long time. They are built to last.

Complete catalog sent upon request

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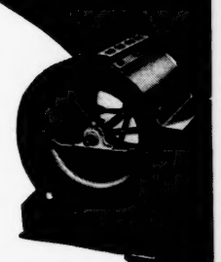
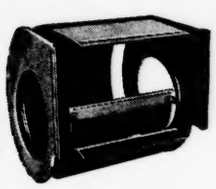
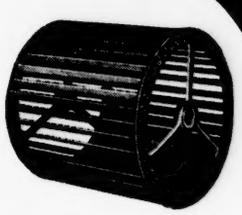
MASSACHUSETTS

BLOWERS



Air Conditioning Furnace Blower Assembly. Designed for manufacturers of warm air furnaces and Air Conditioning equipment. Wheel Sizes 7½" to 27"





Housing Sides—Cutoff Plate and scroll Sheet.

Heavy gauge steel stampings.

End Spider suspension type wheel assembly.

Write for catalogs.

MANUFACTURERS OF CENTRIFUGAL BLOWERS FOR 35 YEARS

MASSACHUSETTS BLOWER DIVISION
The BISHOP & BABCOCK Mfg. Co.
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FIN-TUBE Radiant Coils

Heat from the ceiling...or from walls

☆

Kritzer Radiant Coils heat the air in the joist or stud spaces so that ceilings, walls or floors *become* radiant panels of uniform warmth essential to good heating. Concealed by, but not imbedded in the building materials, they are not subject to the limitations of other systems . . . can be completed and tested without help from other trades. Thousands of installations prove that Kritzer Radiant Coils provide all the advantages of radiant panel heating at lower labor and material costs.

Kritzer Fin-Tube Radiant Coil installations save time, labor and money. Installation is begun and finished as soon as framing is completed and before plastering is started. Because a single Kritzer Radiant Coil supplants many lengths of ordinary tubing, the labor for suspension and joining is drastically reduced.

GET THE FACTS

The construction of a Kritzer Radiant Coil is simple, yet unusually effective. Collared aluminum fins are mechanically bonded to a single copper tube and arranged in sections for a highly multiplied heat transfer surface.

Photograph of typical inside wall panel installation.

KRITZER RADIANT COILS, INC.
2907 WEST LAWRENCE AVENUE, CHICAGO 25, ILL.

Gentlemen: Send me literature on Kritzer Fin-Tube Coils.

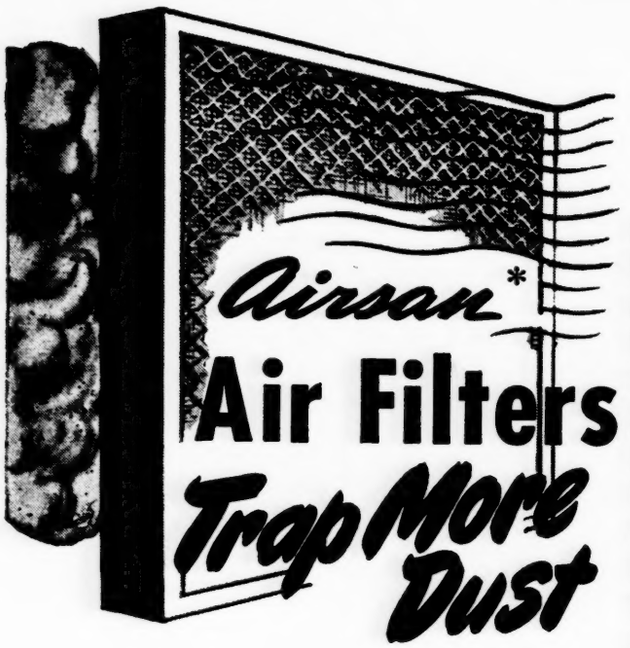
Name _____

Firm _____

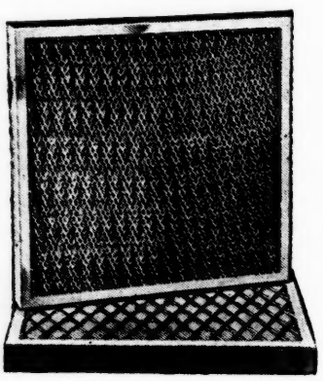
Address _____

City _____ Zone _____ State _____

"IF IT'S KRITZER IT'S RIGHT SIR!"



For Air Conditioning, Heating and Ventilating

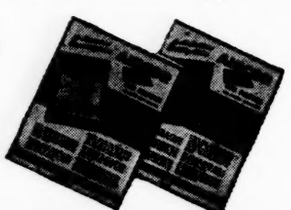


Greater efficiency — lower resistance is yours with an AIRSAN Air Filter.

A permanent, cleanable viscous type filter of all galvanized construction, having full bronze welded corners. Expanded metal face plate acts as lint arrestor to provide easier cleaning and servicing. Rated filtering efficiency 98.5%. In standard 1" and 2" thickness.

Also available for heavy duty service on industrial and special applications — in 2" to 4" thickness. Holding frames (for V-type or straight banks) are made for all type filters.

SEND FOR BULLETINS →



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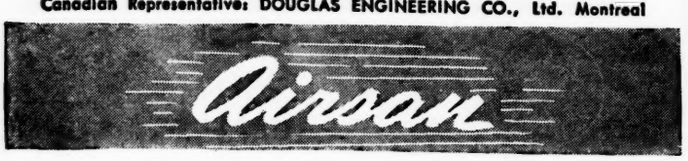
A Few Distributorships Available. Write for Details.
Canadian Representative: DOUGLAS ENGINEERING CO., Ltd. Montreal



with the ASME in bringing about agreement with the ASME unfired pressure vessels code, and with the Underwriters' Laboratories to meet their requirements.

Not only has the code been clarified by elimination of ambiguous phrasing and the addition of many new definitions, but a permanent "interpretations committee" has been established. The code has also been liberalized to some extent with respect to the use of the safest of the three classes of refrigerants and the running of tubing for these refrigerants. Such tubing may now be installed in many places that were formerly forbidden. Copper tubing may now be used without enclosure under some conditions. In a few instances hazards unforeseen in the formulation of the 1939 code have been corrected. Two new refrigerants are recognized. The code is in general much more satisfactory and up to date than the former standard code.

FREEZE DRIER

uses infra-red to put ACTH production up, price down.

The recent 50% price cut on ACTH-Armour, based on a tremendous jump in production, depends in substantial part on an ingenious new type of freeze-drying apparatus which uses infra-red rays as a heat source, according to Armour Laboratories, Chicago.

• **DEVELOPMENT.**—The new equipment, adapted especially for work with ACTH-Armour, speeds up the drying process as much as ten times, and gives a greater yield of the hormone by reducing the loss of potency previously experienced in the drying process. It was developed by a team headed by Ralph F. Colton of the Dry Freeze Corp. of Chicago, on the basis of ideas originally evolved during the war in research on drying blood plasma by Sidney O. Levinson, M.D., and Franz Oppenheimer, Ph.D., famous physicist, both of Michael Reese Research Foundation, Chicago.

ACTH is a pituitary hormone which controls many hitherto unamenable diseases such as arthritis and rheumatic fever, and is regarded as a major tool for the investigation of many mysteries of human physiology. Armour chemists worked out the method of extracting a clinically safe form of it from the pituitary glands of hogs. Hitherto it has been relatively scarce. It is still not approved by the Food and Drug Administration for general sale, but is limited to clinical and other research in hospitals with adequate staffs and facilities.

April 21, however, F. W. Specht, president of Armour and Co., announced that production had reached a level 30 times that of a year ago, that better methods were getting four times as much ACTH from a given quantity of glands, and that further improvements will soon triple the current rate of production. The price, he said, will be cut May 1 from about $210 a gram to $100, more than 50%.

• **PROCESS.**—Freeze-drying depends on the fact that water will evaporate from the solid form (ice) as well

as from the liquid. It is familiar to every housewife who has seen her laundry dry in sub-freezing weather, even though the wet clothes freeze solid as soon as they are exposed to the cold. The water does not return to the liquid form, but leaves the solution molecule by molecule as ice.

If a little heat is applied to the solution, the drying process is speeded up. Placing the solution in a vacuum also hastens drying by making it easier for the water molecules to escape. The dry-freeze process thus consists basically of the frozen solution, a vacuum tank, a heat source just barely above freezing. It has many advantages over room temperature drying. Many biological substances are heat-sensitive and must be dried at low temperatures. In bone-dry powder form they may be kept indefinitely.

At the same time, the materials treated are left in a fluffy powder form, easily dissolved in water for immediate use. If dried at room temperature, they form a solid mass or cake which must often be reground to make it a powder. When dried from the frozen form, the molecules of water leave the molecules of material in just the same position they occupied in the frozen solution, with voids representing the position of the water.

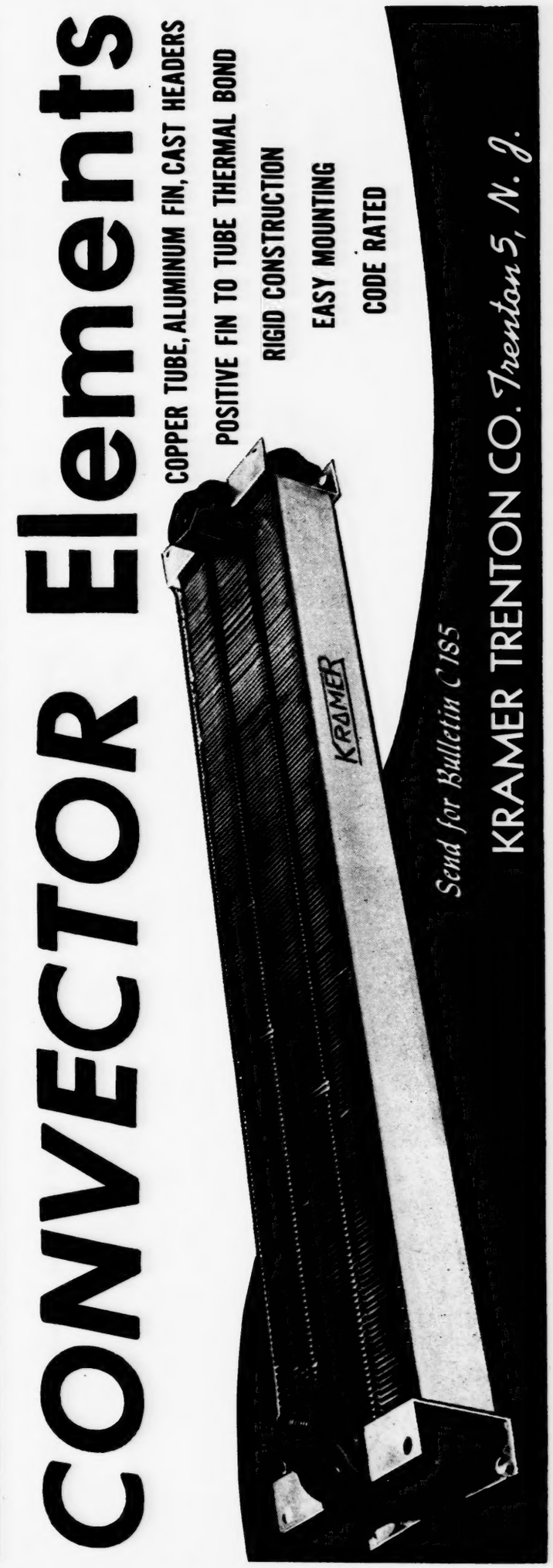
In the ordinary freeze-dry method, the heat was applied by means of a liquid, ethylene glycol, for instance, which was allowed to flow through a shelf on which the vials of frozen solution at about 60 degrees below zero stand in a large vacuum tank. This heat, about 40 degrees above zero, was transferred by contact to the metal of the shelf, then to the glass of the vial, then to the frozen solution, through which it passed to the top, where evaporation takes place. The difference of 100 degrees and the effect of the vacuum dried the material in a matter of several hours.

• **INFRA-RED.**—The new method now being used with ACTH-Armour substitutes infra-red rays for the liquid as a heat source. It takes advantage of the fact that every substance, including water, absorbs only certain wave lengths of radiation and is transparent to and unaffected by others.

The infra-red wave band absorbed by water lies mainly between two and eight microns or 20,000 to 80,000 Angstrom units. (A micron is about one-25,000th of an inch.) This energy, when absorbed directly by the water, heats it to the point where it is evaporated out of the mixture, leaving the dry ACTH behind.

By the infra-red technique, the vials of ACTH-Armour are hung by their necks from a metal rack. The invisible infra-red rays are emitted by a series of fine wires, electrically charged, a few inches below them. Since evaporation takes place from the top surface of the solution, the radiation is applied from the bottom, where there is always water, until all is evaporated.

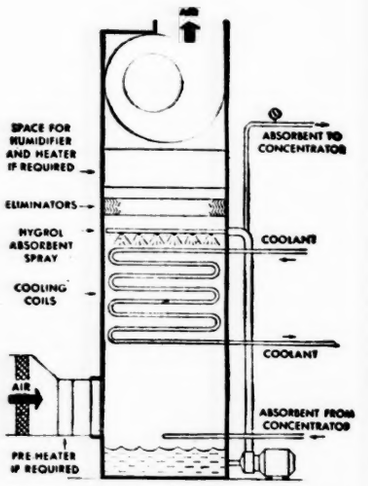
• Edwin Reichert has been appointed advertising manager for the Richmond Radiator Co. Before joining Richmond, Mr. Reichert was assistant advertising manager for the Riegel Paper Corp. and the Riegel Textile Corp.



How You Save with the NEW Niagara Method of Air Conditioning

Using "Hygrol" Hygienic Absorbent Liquid

Because it absorbs moisture from the air directly, the new Niagara Controlled Humidity Method uses less, or no, mechanical refrigeration for dehumidifying. You save first costs and installing of heavy machinery. You save space, maintenance expense, power. Easier, convenient operation.

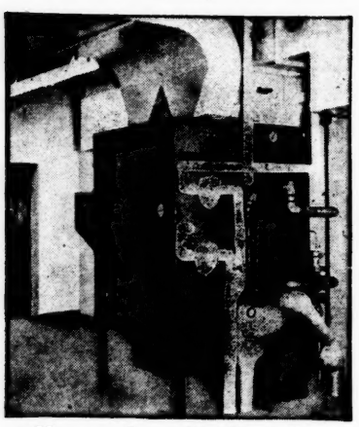


NIAGARA CONTROLLED HUMIDITY METHOD — FLOW DIAGRAM

Using "Hygrol" hygienic absorbent liquid, this method gives complete control of temperature and relative humidity. Especially, it is a better way to obtain dry air for drying processes, packaging hygroscopic materials, preventing moisture damage to metals, and obtaining better quality for chemical process products and food products—or in obtaining better results in comfort air conditioning for office or laboratory at lower refrigeration costs.

The diagram shows how filtered air is dehumidified by passing thru a spray of "Hygrol"— a liquid absorbent which removes air-borne moisture. This liquid is hygienic and non-corrosive; it contains no salts or solids to precipitate and cause maintenance troubles. It is continuously reconcentrated at the same rate at which it absorbs moisture, providing always the full capacity of the air conditioner, automatically.

Food Packaging under Controlled Humidity


Niagara Controlled Humidity Air Conditioner

Units provide a range of capacities from 1000 to 20,000 C. F. M. Multiple unit installations are in use successfully. Records of results are available.

For further information, write to Niagara Blower Company, Dept. HV, 405 Lexington Ave., New York 17, N. Y.

ALUMINUM NOMENCLATURE

for sheet and plate standardized.

To clarify the designation of aluminum sheet and plate, the Sheet Division of The Aluminum Association has adopted standard nomenclature for these products, Donald M. White, secretary of the association has announced.

The following definitions were adopted:

(1) *Plate* is a solid section rolled to a thickness of 0.250 inch and heavier, in rectangular form with either sheared or sawed edges.

(2) *Sheet* is a solid section rolled to a thickness range of 0.006 inch to 0.249 inch inclusive, supplied with sheared, slit, or sawed edges.

(a) *Flat Sheet* is furnished in rectangular form with sheared, slit, or sawed edges, which may be flattened by any standard method.

(b) *Coiled Sheet* is furnished in rolls (coils) with slit edges.

Heretofore, the terms *strip* and *coiled sheet* were applied interchangeably to the same product, but the new nomenclature officially recognizes the latter, more descriptive term.

The definitions were formulated by a Sheet Division committee comprised of representatives of the Aluminum Company of America, Pittsburgh, Pa.; Sheet Aluminum Corp., Jackson, Mich; Kaiser Aluminum and Chemical Corp., Oakland, Calif.; Reynolds Metals Co., Louisville, Ky.; Revere Copper and Brass, Inc., Baltimore, Md.; and Fairmont Aluminum Co., Fairmont, W. Va.

HIGH TEMPERATURE THERMOSTAT

developed for precision control of electric furnace

An improved precision thermostat developed by Dr. Wm. R. Eubank at the National Bureau of Standards provides smooth, continuous control of an electric furnace within a very small range at temperatures between 1832F and 2822F. The device is of the type in which the furnace winding itself serves as the sensitive element, forming part of a bridge circuit for control of a thyratron tube. The thyratron circuit then acts as a continuously variable valve, allowing just enough current to reach the furnace to compensate for a given temperature fluctuation. The new thermostat is highly sensitive and independent of normal fluctuations in line voltage. As it is convenient to operate, easily adjusted for any temperature, and reliable for periods of continuous operation from a few minutes to several days, it should provide a useful research tool in such fields as metallurgy, ceramics, glass technology, and cement chemistry, where automatic control of furnace temperatures has long been a problem. The thermostat maintains furnace temperatures constant within $\pm$ 0.1 degree for several hours, and within $\pm$ 1.0 degree for several days.

• **OPERATION.**—In the Bureau's thermostat, the output of an a-c bridge, one arm of which serves both as

a resistance thermometer and as a heater element for the furnace, is amplified and applied to the control grid of a thyratron. When the resistance of the furnace winding changes slightly with temperature, the resulting unbalance of the bridge produces a difference in phase between the control voltage and the anode voltage of the thyratron. This phase difference determines the firing period of the thyratron, and the thyratron action is reflected to the bridge circuit through a transformer, thus controlling the amount of energy supplied to the furnace.

NEWS BRIEFS

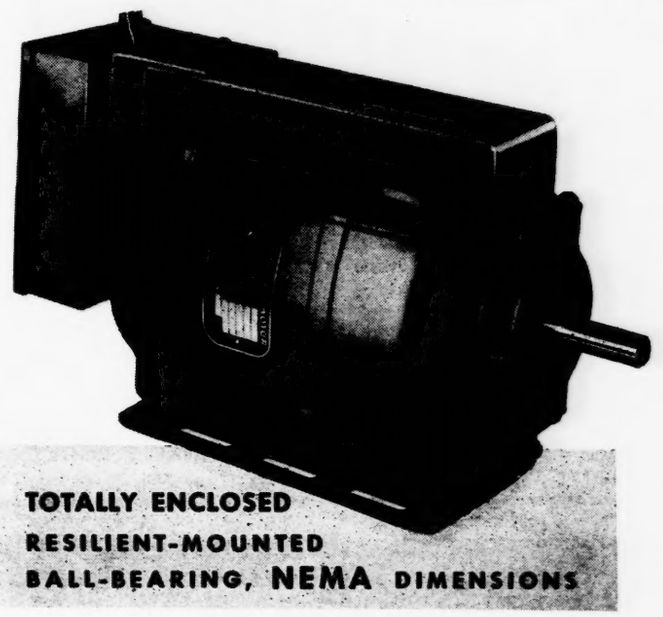
• Arthur H. Timmerman, nationally known veteran of the electrical industry and until March of this year a vice-president of Wagner Electric Corp., died in Dallas, Texas, on Tuesday, July 18, at the age of 79. He became ill while on a vacation trip, and had been in a Dallas hospital for several weeks prior to his death. Mr. Timmerman was born in New York City in 1871 and graduated from the City College of New York in 1891 with a Bachelor of Science Degree. He then entered Cornell University and was graduated with a Master's Degree in Mechanical Engineering in 1893. After graduation, he came to St. Louis as an instructor of physics at Washington University. The next year he became professor of physics and electrical engineering at the Missouri School of Mines and Metallurgy. Mr. Timmerman's industrial career began in 1899, when he joined the Wagner company. He was chief engineer from 1908 to 1919, when be became vice-president, and in 1925 he was elected a director. He retired March 20, 1950, after fifty years with the company.

• Doctor Arthur Cutts Willard, President Emeritus of the University of Illinois, was recognized for his engineering abilities by the National Warm Air Heating and Air Conditioning Association on May 12 by a surprise feature at the dedicatory program of the new University of Illinois mechanical engineering building. Doctor Willard's name and research will be perpetuated with the hanging of a bronze tablet fittingly inscribed in the foyer of the new mechanical engineering building.

• Charles G. Witherspoon, president and chairman of the board of Baker, Smith & Co., Inc., heating, ventilating and air conditioning contractors, New York, is beginning his 61st year with the firm. He has been associated with the company since July 14, 1890, when he began work as an office boy. Mr. Witherspoon became vice-president of Baker, Smith & Co. in 1915. Three years later he became president, taking the place of Charles H. Smith who retired. He resigned as president in 1938, reorganizing the company and financing the chief members of his staff in purchase of stock in the firm. He then became chairman of the board. In 1945, however, Mr. Witherspoon again assumed the presidency but continued to retain his position as board chairman. Baker, Smith & Co. will celebrate its 100th anniversary in 1957.

BALDOR 4-Purpose Motor

for fan, blower and unit heater applications



TOTALLY ENCLOSED
RESILIENT-MOUNTED
BALL-BEARING, NEMA DIMENSIONS

BALDOR 4-purpose Motor for fan, blower and unit heater applications have these IMPORTANT FEATURES:

Constant speed:	115 volt
Two-speed:	115 volt
Constant speed:	230 volt
Two-speed:	230 volt

. . . quiet, vibrationless operation. Resilient Gimbal-mounted. Rubber-mounted knock-out box, insulated from motor frame, prevents transmission of noise and vibration.

. . . metal strup over motor prevents motor from springing out of cradle mounting rings.

. . . motor operates with shaft either vertical or horizontal.

BALDOR ELECTRIC CO. • ST. LOUIS

Baldor

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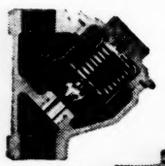
Nicholson Traps

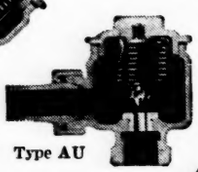
UP STEAM FLOW 50%

for Leading Processor

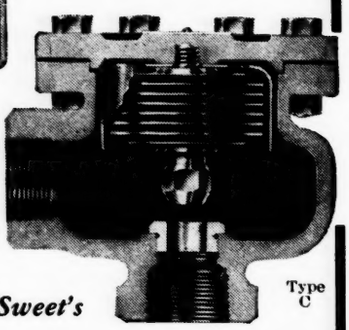
A striking increase in steam flow from 2000 to 3000 lbs. an hour is reported by a chemical maker who recently replaced a mechanical trap with Nicholsons. This cut cooking time from 105 to 55 min., a gratifying speed-up of 48%. Also widely recommended for their effective venting of non-condensible gases in critical applications.



Type AHV



Type AU



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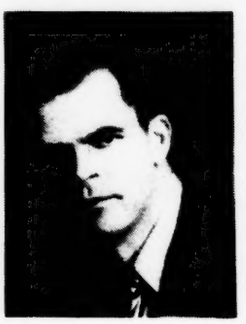
Getting Personal

J. S. Matheweson

J. S. Mathewson (*Behavior of Radiant Heated Hardwood Floors*, page 63) since graduation as a mechanical engineer from the University of Cincinnati has served as an instructor in the Engineering College of the University of Akron and as an engineer at the U. S. Forest Products Laboratory, Forest Service, Madison 5, Wis. In his present position he has been engaged primarily in research relating to the air seasoning, kiln drying and storage problems pertaining to lumber, crossties and poles. He is author of Technical Bulletin 714, "The Air Seasoning of Wood," and of a number of articles in trade journals relating to his research.

Robert H. Weigel (coauthor, *Tested Practice in Steam and Hot Water Heating for Houses*, page 67) received a Bachelor of Mechanical Engineering degree from the University of Louisville in 1935. Upon graduation he was employed by The Louisville Gas and Electric Company as an assistant to the gas distribution engineer. He served in this capacity until 1941 and from there went into the services of the War Department as instructor-supervisor of aircraft fuel systems and engines. In 1947 he entered the graduate school of the University of Illinois to specialize in heating and ventilation, receiving his M.S. degree in 1949. During this period, and until the present time, he has served as special research assistant at the I=B=R Research Home under the supervision of Professor W. S. Harris. In September he will join the research and development staff of National Radiator Co.

R. H. Weigel



W. S. Harris

W. S. Harris (coauthor, *Tested Practice in Steam and Hot Water Heating for Houses*, page 67) received a Bachelor of Science degree in Mechanical Engineering from the University of Illinois in 1930 and a Master of Science degree from the University of Illinois in 1933. During graduate work he majored in heating and ventilating, taking work under Dr. Willard and Professor Kratz. During the time of graduate study he served as part-time assistant at the Warm Air Research Residence under the supervision of Professor Konzo.

After receiving the Master's degree he was employed one year in the research laboratory of the Philadelphia and Reading Coal and Iron Company, Pottsville, Pennsylvania, and from there went to the Delco Appliance Division of General Motors, Rochester, New York, to take charge of their thermal research and development laboratory. He was employed by Delco Appliance division from 1934 to 1940. In 1940 the Institute of Boiler and Radiator Manufacturers entered into a cooperative agreement with the University of Illinois to conduct research on steam and hot

water heating systems and he was invited to take charge of this work, which involved the construction of a six-room house in which to run the tests and its subsequent operation. Since 1940 he has been in charge of the experimental research work at the University of Illinois being done under the terms of the cooperative agreement with the Institute of Boiler and Radiator Manufacturers.

E. A. Cline *(Convection Heating for Schools*, page 83) is assistant general sales manager of The Trane Co., La Crosse, Wis. Prior to assuming his present position he was manager of the Convector Sales Department. In 1949 he was elected president of the Convector Manufacturers Association after serving as secretary of that organization during 1948.

COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available.

INSTRUMENT CONFERENCE—5th national instrument conference and exhibit, of The Instrument Society of America, at Memorial Auditorium, Buffalo, N. Y. Richard Rimbach, executive secretary of the Society, 921 Ridge Ave., Pittsburgh 12, Pa. ..... **SEPTEMBER 18-22, 1950.**

INTERNATIONAL ENGINEERING CONGRESS — Third International Mechanical Engineering Congress, sponsored by The British Engineers' Association, to be held in Brussels, Belgium. A. W. Berry, Director of Association, 32 Victoria St., London, S.W. 1, England. .....**SEPTEMBER 18-23, 1950.**

PETROLEUM CONFERENCE—Petroleum Mechanical Engineering Conference, at Hotel Roosevelt, New Orleans, La. Secretary, American Petroleum Institute, 50 W. 50th St., New York, N. Y. .....**SEPTEMBER 25-27, 1950.**

AGA CONVENTION AND EXPOSITION—Biennial Exposition of Gas Appliances and Equipment, in conjunction with 1950 annual convention of the American Gas Association, at Convention Hall, Atlantic City, N. J. Secretary, AGA, 420 Lexington Avenue, New York 17, N. Y., and secretary, Gas Appliance Manufacturers Association, 60 E. 42nd St., New York 17, N. Y .....**OCTOBER 2-6, 1950.**

INSTRUMENTATION SYMPOSIUM—Fifth annual symposium on Instrumentation for the Process Industries, at the Agricultural and Mechanical College of Texas, College Station, Texas. Prof. P. G. Murdock, chemical engineering department, at Texas A & M College. .....**OCTOBER 11-13, 1950.**

ASME CONFERENCE—Fuels Division conference of the American Society of Mechanical Engineers, at Hotel Statler, Cleveland, Ohio. C. E. Davies, secretary of the Society, 29 W. 39th St., New York, N. Y. .....**OCTOBER 23-25, 1950.**

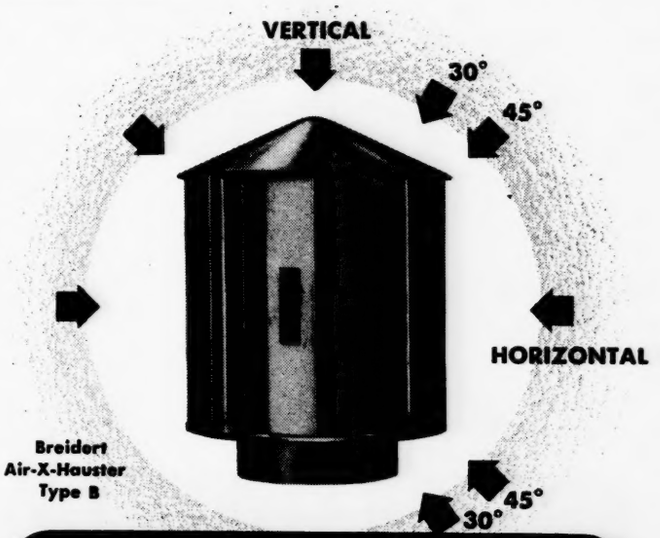
METALS MEETING—Annual meeting of the American Society for Metals, in Chicago, Ill. For hotel and other details, write W. H. Eisenman, national secretary, 7301 Euclid Ave., Cleveland 3, Ohio. .....**OCTOBER 23-27, 1950.**

WELDING MEETING—Annual meeting of the American Welding Society, in Chicago, Ill. For hotel and other details, write J. G. Magrath, national secretary, 33 W. 39th St., New York 18, N. Y. .....**OCTOBER 23-27, 1950.**

REFRIGERATION WEST COAST EXHIBIT—West Coast Educational Exhibit and Conference, of the Refrigeration Equipment Manufacturers Association, at Municipal Auditorium in Long Beach, Calif., to be held simultaneously with 5th annual convention of the Refrigeration & Air Conditioning Contractors Association. Edna Berggren, executive secretary, 228 No. La Salle St., Chicago 1, Ill. .....**NOVEMBER 17-19, 1950.**

(Concluded on page 128)

First Ventilator with Certified Capacity Ratings!



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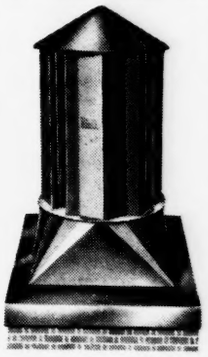

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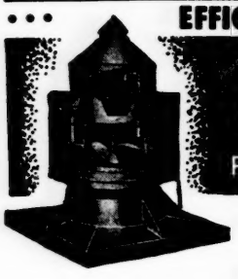

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For stores, cafes, bakeries, laundries, garages, etc. Built to function in wet air—motor is out of line of air flow. A compact, sturdy, easy-to-install package unit. Sizes 370 to 13,080 C.F.M. air delivery. Fits any roof. *Write us about YOUR problem.*

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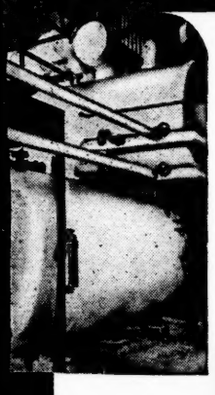

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1835 S. 54th Ave., Chicago 50, Ill.
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Adhesives? ... ARABOL!

(Concluded from page 127)

ASME MEETING—Annual meeting of the American Society of Mechanical Engineers, at the Hotel Statler, New York, N. Y. C. E. Davies, secretary of the Society, 29 W. 39th St., New York, N. Y. .....**NOVEMBER 26—DECEMBER 1, 1950.**

POWER SHOW — 19th National Exposition of Power and Mechanical Engineering, sponsored by the American Society of Mechanical Engineers, in conjunction with the society's annual meeting, at Grand Central Palace, New York, N. Y. Charles F. Roth, president, International Exposition Company, Grand Central Palace, New York.....**NOVEMBER 27—DECEMBER 2, 1950.**

ASRE MEETING—Annual convention of the American Society of Refrigerating Engineers, at Hotel Commodore, New York. M. C. Turpin, secretary, 40 W. 40th St., New York 18, N. Y. .....**DECEMBER 3-6, 1950.**

AUTOMOTIVE ENGINEERS MEETING—Annual meeting and engineering display, of the Society of Automotive Engineers, at the Hotel Book-Cadillac, Detroit, Mich. John A. C. Warner, secretary of the Society, 29 West 39th Street, New York, N. Y. .....**JANUARY 8-12, 1951.**

PLANT MAINTENANCE SHOW AND CONFERENCE—2nd plant maintenance show and conference, at the Auditorium, Cleveland, Ohio. Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y. .....**JANUARY 15-18, 1951.**

ASHVE MEETING—57th annual meeting of the American Society of Heating and Ventilating Engineers, at the Bellevue-Stratford, Philadelphia, Pa. A. V. Hutchinson, secretary of the Society, 51 Madison Ave., New York 10, N. Y. **JANUARY 22-25, 1951.**

ASHVE EXPOSITION—10th International Heating and Ventilating Exposition under the auspices of the American Society of Heating and Ventilating Engineers, at the Commercial Museum, Philadelphia, Pa. Charles F. Roth, manager of the International Exposition Company, Grand Central Palace, New York 17, N. Y. .....**JANUARY 22-26, 1951.**

FOUNDRYMEN'S CONVENTION—55th annual convention of the American Foundrymen's Society, in Buffalo, New York. William W. Maloney, secretary-treasurer of the Society, 616 S. Michigan Ave., Chicago 5, Ill. .....**APRIL 23-26, 1951.**

REFRIGERATION MEETING—Annual meeting of the Refrigeration Equipment Manufacturers Association, at The Homestead, Hot Springs, Va. George E. Mills, public relations director, REMA, 1346 Connecticut Ave., N.W., Washington, D. C. .....**APRIL 30—MAY 2, 1951.**

ARCHITECTS CONVENTION—1951 convention and national seminar meetings of The American Institute of Architects, at the Edgewater Beach Hotel, Chicago, Ill. Paul Gerhardt, Jr., chairman, 121 No. LaSalle St., Chicago, Ill. **MAY 8-11, 1951.**

NDHA MEETING—42nd annual meeting of the National District Heating Association, at the Statler Hotel, Detroit, Mich. John F. Collins, Jr., secretary-treasurer of the Association, 827 N. Euclid Ave., Pittsburgh 6, Pa.....**JUNE 5-8, 1951.**

INSTRUMENT CONFERENCE AND EXHIBIT—1951 Instrument conference and national exhibit of the Instrument Society of America, at the Coliseum, Houston, Tex. John McCaffery, assistant executive secretary of the Society, 921 Ridge Ave., Pittsburgh 12, Pa. .....**SEPTEMBER 10-14, 1951.**

REFRIGERATION SHOW—7th All-Industry Refrigeration and Air Conditioning Exposition, at Navy Pier, Chicago, Ill. Show director, REMA, 1346 Connecticut Ave., N.W., Washington, D. C. .....**NOVEMBER 5-9, 1951.**

Bind in

GAS UTILITIES, TYPE OF GAS AND HEAT VALUE OF GAS IN IMPORTANT U. S. CITIES

The following data are correct as of October, 1949. Abstracted by permission from "Survey of Residential Gas Service," American Gas Association, 1950. (*) indicates cities where the outlook is that natural gas will be available through pipe lines planned or under way as of mid-1950.

City and State	Name of Utility	Type of Gas	Btu per Cu. Ft.
ALABAMA			
Birmingham	Alabama Gas Corp.	Nat.	1025
Mobile	Mobile Gas Service Corp.	Nat.	1077
ARIZONA			
Phoenix	Central Arizona Light & Power Co.	Nat.	1093
ARKANSAS			
Little Rock	Arkansas Louisiana Gas Co.	Nat.	1000
CALIFORNIA			
Berkeley	Pacific Gas & Electric Co.	Nat.	1050
Glendale	Southern California Gas Co.	Nat.	1100
Long Beach	Long Beach Gas Department	Nat.	1070
Los Angeles	Southern California Gas Co.	Nat.	1100
	Southern Counties Gas Co.	Nat.	1125
Oakland	Pacific Gas & Electric Co.	Nat.	1050
Sacramento	Pacific Gas & Electric Co.	Nat.	1000
San Diego	San Diego Gas & Electric Co.	Nat.	1100
San Francisco	Pacific Gas & Electric Co.	Nat.	1100
COLORADO			
Denver	Public Service Co. of Colorado	Nat.	840
CONNECTICUT			
Bridgeport*	The Bridgeport Gas Light Co.	Mfd.	528
Hartford*	The Hartford Gas Co.	Mfd.	528
New Haven	New Haven Gas Light Co.	Mfd.	528
DELAWARE			
Wilmington*	Delaware Power & Light Co.	Mfd.	520
D. C.			
Washington	Washington Gas Light Co.	Nat.	1150
FLORIDA			
Jacksonville*	Jacksonville Gas Co.	Mfd.	520
Miami	Florida Power & Light Co.	Mfd.	550
GEORGIA			
Atlanta	Atlanta Gas Light Co.	Nat.	1030
Savannah*	South Atlantic Gas Co.	Mfd.	530
ILLINOIS			
Chicago	The Peoples Gas Light & Coke Co.	Mix.	800
Evanston	Public Service Co. of Northern Illinois	Nat.	1000
Peoria	Central Illinois Light Co.	Nat.	1000
Rockford	Central Illinois Electric & Gas Co.	Nat.	1028
INDIANA			
Evansville	Southern Indiana Gas & Electric Co.	Nat.	1020
Fort Wayne	Northern Indiana Public Service Co.	Nat.	1000
Gary	Northern Indiana Public Service Co.	Mix.	1000
Indianapolis	Citizens Gas & Coke Utility	Mfd.	570
South Bend	Northern Indiana Public Service Co.	Mix.	570
Terre Haute	Terre Haute Gas Corp.	Mfd.	570
IOWA			
Des Moines	Iowa Power & Light Co.	Nat.	1000
Sioux City	Iowa Public Service Co.	Mix.	900
KANSAS			
Kansas City	The Gas Service Co.	Nat.	1000
Topeka	The Gas Service Co.	Nat.	1000
Wichita	The Gas Service Co.	Nat.	1000
	Consolidated Gas Utilities Corp.	Nat.	1040
KENTUCKY			
Louisville	Louisville Gas & Electric Co.	Mix.	900
LOUISIANA			
New Orleans	New Orleans Public Service, Inc.	Nat.	1109
Shreveport	Arkansas Louisiana Gas Co.	Nat.	1000
MAINE			
Portland	Portland Gas Light Co.	Mfd.	577
MARYLAND			
Baltimore*	Consolidated Gas, Electric Light & Power Co. of Baltimore	Mfd.	500
MASSACHUSETTS			
Boston*	Boston Consolidated Gas Co.	Mfd.	528
Cambridge*	Cambridge Gas Light Co.	Mfd.	950
Fall River	Fall River Gas Works Co.	Mfd.	581
Lowell	Lowell Gas Light Co.	Mfd.	660
Lynn	Lynn Gas & Electric Co.	Mfd.	615
New Bedford	New Bedford Gas & Edison Light Co.	Mfd.	660
Springfield*	Springfield Gas Light Co.	Mfd.	531
Worcester	Worcester Gas Light Co.	Mfd.	660
MICHIGAN			
Detroit	Michigan Consolidated Gas Co.	Nat.	1005
Flint	Consumers Power Co.	Nat.	1000
Grand Rapids	Michigan Consolidated Gas Co.	Nat.	1007
Saginaw	Consumers Power Co.	Nat.	1000
MINNESOTA			
Duluth	Duluth Water, Gas & Sewer Disp. Dept.	Mfd.	530
Minneapolis	Minneapolis Gas Light Co.	Nat.	1005
St. Paul	Northern States Power Co.	Nat.	1000
MISSISSIPPI			
Jackson	Mississippi Power & Light Co.	Nat.	1000
MISSOURI			
Kansas City	Gas Service Co.	Nat.	1000
St. Louis	The Laclede Gas Light Co.	Nat.	990